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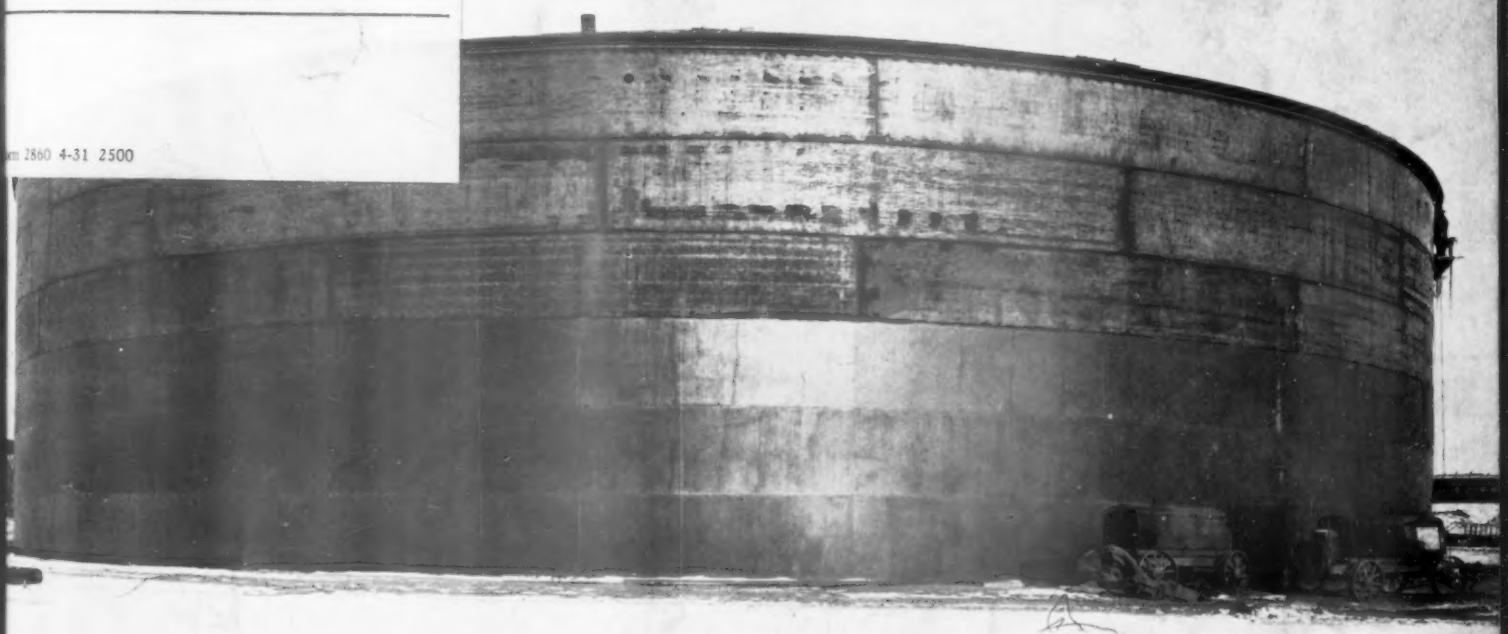

Six Million Gallon Welded Tank (See Page 24)

December
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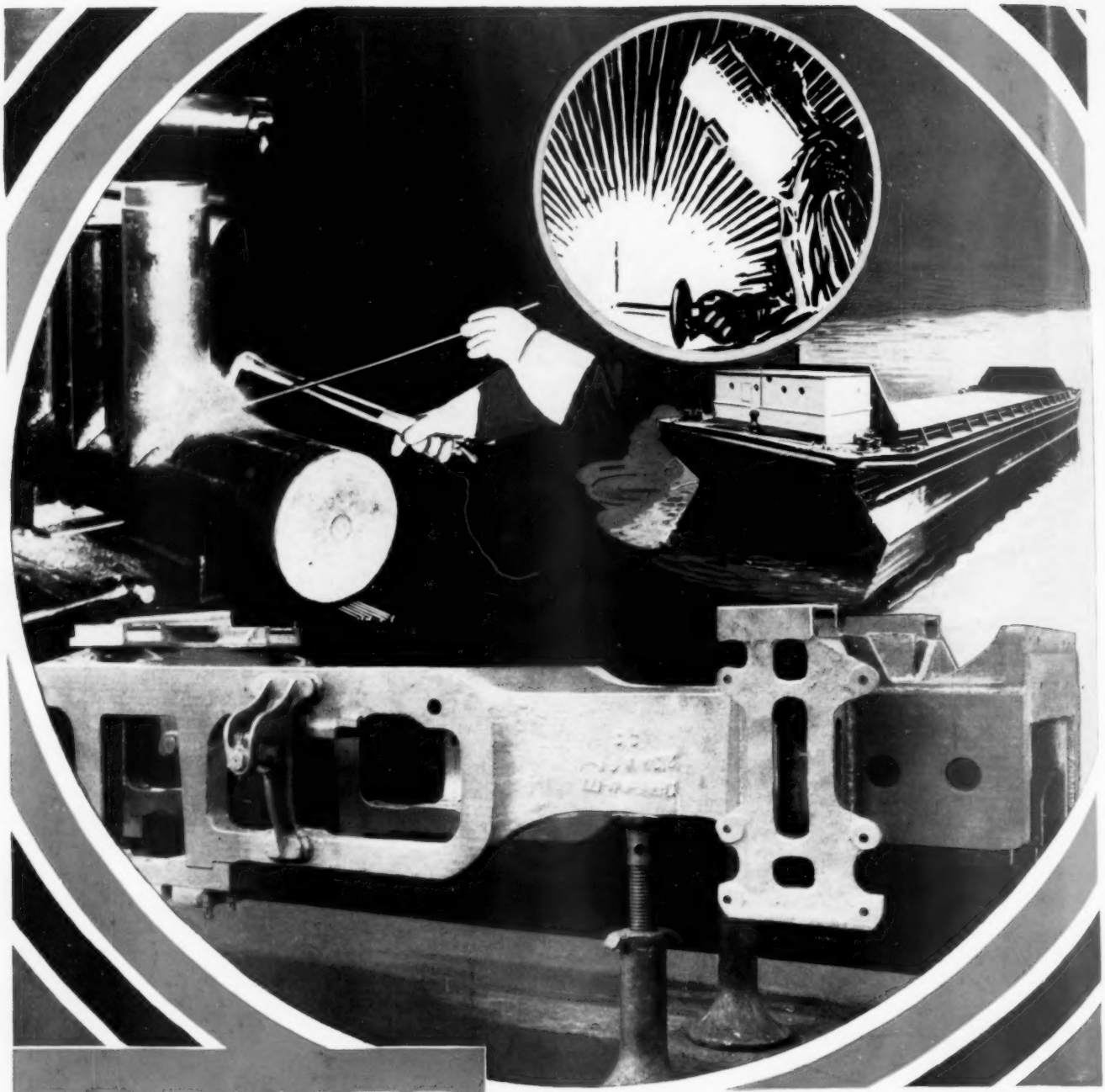

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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The architect, contractor, and home owner, all profit when welded piping with long sweep bends is used in new home construction

Economic Advantages of

Welded Piping in Homes

By **Fred Maeurer**
Air Reduction Sales Company

(Paper presented at the 33rd annual meeting of the International Acetylene Association, held in Philadelphia, Pa., November 16 to 18, 1932. Slightly abridged.)

THE substitution of the oxyacetylene process of welding and cutting in place of the conventional threaded fittings and threaded pipe for pipe fabrication in heating installations in the home is based on sound fundamentals. Such a change to be justified must result in benefits to every individual or group connected with the (1) planning, (2) putting of the plans into effect, and (3) the use of the finished installation.

In a piping installation the above three groups would be (1) the architect, who plans the installation so that he is assured that it is correct in every detail, will operate efficiently and economically and is best for his client, (2) the heating contractor who must be assured that the piping installation will be better than the previous method used, that he isn't penalized with additional costs, and that it operates efficiently and economically, and (3) the ultimate user or home owner, who must be assured that his piping installation will be enduring, have small maintenance cost, have minimum friction losses, and that he can deliver steam within the pipe to its objective at the least possible cost—in other words, that he will use the least amount of fuel to operate it efficiently and economically.

Now it is possible, with welding, to give each one of these groups an easily planned, readily fabricated, efficient piping installation; and that was not possible before the advent of the oxyacetylene welding and cutting processes, which, on top of it all, bring to each group economies that are not possible with the old method of threaded fittings and threaded pipe.

For the architect, welded pipe now brings true his dream of smooth interior of pipe throughout the entire piping installation, long sweep bends, less heat losses, smaller pipe sizes, less weight, flexibility, ease of changes without affecting plans, and the best possible installation for his client. These advantages were not open or possible for him heretofore. The advantages of long sweep bends are very important at this particular time because they are being heavily stressed on piping of larger sizes, particularly on power piping installations.

To the heating contractor the welding of smaller pipe sizes in home piping installations offers very definite economies not available with the older method of threaded fittings and threaded pipe. With the welding of pipe he finds economies in labor cost, material costs, insulation costs, and what is far more important, a better and more enduring piping installation for the owner of the home.

To the home owner or ultimate user there comes for the first time the possession of a heating installation that meets with his demands, and he soon finds that a welded piping installation offers very definite economies for him not before possible.

With smooth interior and exterior of his welded piping and long sweep bends, he finds that his friction losses are reduced to the minimum, that the magnesia insulation can be perfectly fitted on the smooth outside of welded pipe, that he eliminates costly heat losses, that he can carry a boiler temperature of from 5 to 15 degrees lower than is necessary with threaded fittings and threaded pipe and that he is delivering the steam within the pipe to its objective at the least possible cost. All of this means to him lower fuel bills. He has a permanent piping installation with the least possible number of joints, and one whose maintenance costs are reduced to the minimum.

So in suggesting a change in this particular piping fabrication we have endeavored to show that there are ample reasons as to why the change should be made and to indicate some of the benefits that will accrue to all interested —architect, contractor and home owner—that will guide them in promoting this change in heating and piping practice.

Figure 1 shows a typical piping installation fabricated by the old method of threaded fittings and threaded pipe. This installation contains 242 threaded fittings and definitely shows short, sharp bends at each joint that naturally set up heavy friction losses and involve much cutting and threading of pipe. Figure 2 lists all material costs of this piping installation but *does not include labor costs.*

THREADED

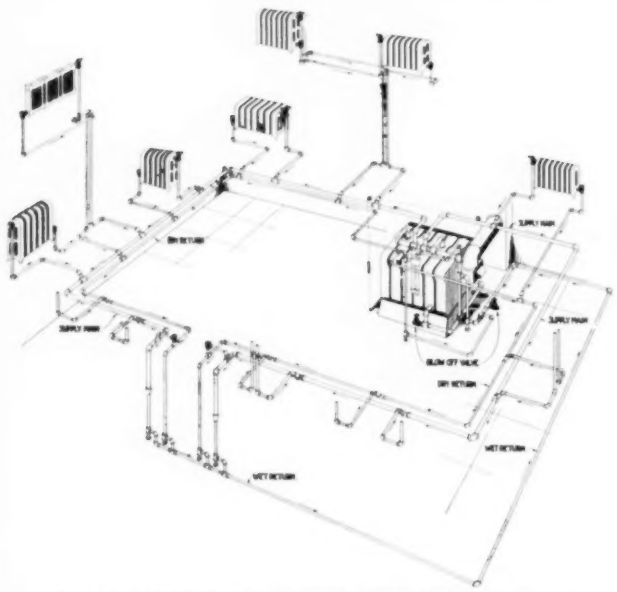


Fig. 1. Threaded Pipe Heating Installation for Home.

WELDED

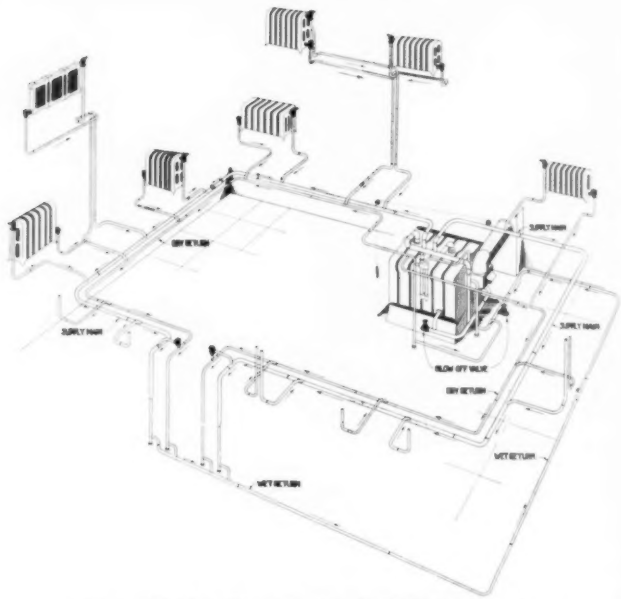


Fig. 3. Welded Pipe Heating Installation for Home.

MATERIAL LIST

NO REQD	DESCRIPTION	COST
5	LIN FT. 2½" STANDARD BLACK IRON PIPE	
120	" " 2" " " " "	
210	" " 1¼" " " " "	$ 55.28
110	" " 1" " " " "	
110	" " ¾" " " " "	
3	2½" - 90° C I ELL	
17	2" - " " "	
32	1¼" - " " "	
30	1" - " " "	
30	¾" - " " "	
4	1¼" - 45° " "	
9	1" - " " "	
5	¾" - " " "	
3	1¼" TO 1" - 90° C I REDUCING ELL	
4	1" - ¾" - " " "	
1	2½" X 2½" X 2½" STD C I TEE	
1	2" X 2" X 2" " "	
7	1¼" X 1¼" X 1¼" " "	
2	1" X 1" X 1" " "	
2	¾" X ¾" X ¾" " "	36.15
2	2½" X 2½" X 2" REDUCING TEE	
3	2" X 2" X 1¼" " "	
9	2" X 2" X 1" " "	
6	1¼" X 1¼" X 1" " "	
5	1¼" X 1¼" X ¾" " "	
1	1" X 1" X ¾" " "	
2	2" TO 1¼" M I REDUCER	
6	1¼" M I PIPE CAPS	
6	2" X 6" BLACK WROUGHT NIPPLE	
10	1¼" X 6" " "	
6	1¼" X 3" " "	
19	1" X 6" " "	
11	¾" X 6" " "	
2	2½" CL " "	
4	1¼" " " "	
1	CAN RED LEAD	85
	85% MAGNESIA INSULATION	243.24
	TOTAL	$335.52

THREADED

Fig. 2. Specifications and Material Cost of Threaded Pipe Installation Shown in Fig. 1.

MATERIAL LIST

NO REQD	DESCRIPTION	COST
5	LIN FT 2½" STANDARD BLACK IRON PIPE	
120	" " 2" " " " "	
210	" " 1¼" " " " "	$ 53.65
110	" " 1" " " " "	
110	" " ¾" " " " "	
4	2½" 90° WELDING ELL	
2	2" 90° " "	9.38
1	2½" TO 2" " REDUCER	
6	1¼" M I PIPE CAPS. SCREWED	
	ACETYLENE, OXYGEN & WELDING ROD	9.60
	85% MAGNESIA INSULATION	228.43
	TOTAL	$ 301.06

PLAIN ENDS

Fig. 4. Specifications and Material Cost of Welded Pipe Installation Shown in Fig. 3.

Weld or thread? Which shall it be? The threaded installation has 242 fittings (see material list at left), compared with 13 fittings for the welded job (above). In addition, the welded job is less expensive and offers less friction to steam or water flow.

All material costs were received from national companies after submitting blueprints of installation for estimates, and all prices are net.

Figure 3 is the same type of piping installation as in Figure 1 but shows all joints welded and using long sweep bends. In this entire welded installation we use thirteen welding fittings and employ wherever possible long sweep bends by bending pipe on the job or in the shop, thereby eliminating fittings. Figure 4 lists all material costs of this welded installation but *does not include labor costs*. All material costs were received from national companies after submitting blueprints of installation for estimates, and all prices are net.

Welding Sales 10% in Material Cost

The total material cost savings for the welded long sweep bend installation is 10.3%; but this does not by any means represent the total savings possible, because there is a very substantial saving to be had in the labor necessary for this and similar types of welded pipe installations.

The type of piping installation shown in Figures 1 and 3 were submitted to three national engineers and three prominent plumbing and heating contractors for their opinions on accuracy and practicability for both design and method of installation and received from them their indorsement.

A close study of the method of installing the welded installation (Figure 3) will show that, outside of the header on the boiler, no welding fittings are specified and all changes of direction in piping call for long sweep bends made by bending the pipe either in the shop before being sent to the job or bending it right on the job. The bending of pipe for this purpose is thoroughly practicable. In the smaller-size pipe, bending can be done cold while larger-size pipe can be quickly heated by the oxyacetylene flame and then slowly bent to the desired angle. With smaller-size pipe, bending can be readily accomplished by inserting smaller pipe in a pipe of larger diameter, then bending to the desired angle; and with the larger-size pipe, a pipe vise can be used to hold the pipe while heating and bending is taking place.

It is highly probable, and we make the prediction that in the not far distant future, piping installations such as shown in Figure 3 will be entirely fabricated in the shop, taken to the job, and assembled along the same line as followed in bridge construction and other types of fabrication.

Threaded Fittings Retard Flow of Steam

The greater the number of threaded fittings used, the greater the amount of friction set up and the greater the amount of fuel which must be used to bring steam within the pipe to its objective. Naturally, in a pipe installation having the least amount of obstructions in its fabrication, resulting in a smaller number of short-radius bends and a greater number of long sweep bends, such as is obtained by bending long lengths, the least amount of fuel is consumed to deliver steam within the pipe to its objective. We are assuming the same size of pipe is being used in both installations.

We have stressed friction losses because this is important, and because friction loss in small pipe sizes has not been given the attention it warrants. Previously nothing could be done about it outside of using larger pipe sizes to compensate for the losses due to sharp bends and fittings, as there was no other way of joining pipe together than by using threaded fittings and threaded pipe. The advent of oxyacetylene welding and cutting has very definitely changed this view and practice because with welded piping and long sweep bends in an installation it has been definitely proven that it was not necessary to increase pipe sizes to overcome friction losses but that pipe sizes could be reduced.

To fully illustrate the friction losses that are set up in an all-threaded fittings and threaded piping installation and to clearly show what we have said about the smooth interior and exterior of welded joints and long sweep bends that reduce friction losses, Figure 5 shows one important section of piping that leads from the supply line to the radiator.

Long Sweep Bends Eliminate Fittings

In the top section are three views of a threaded-fitting and threaded-pipe fabrication that very clearly shows the short angle bends and the roughness on the inside of the pipe at the joint. The lower section shows the same three views of the same fabrication that is welded, with long sweep bends used as described above; note that there is

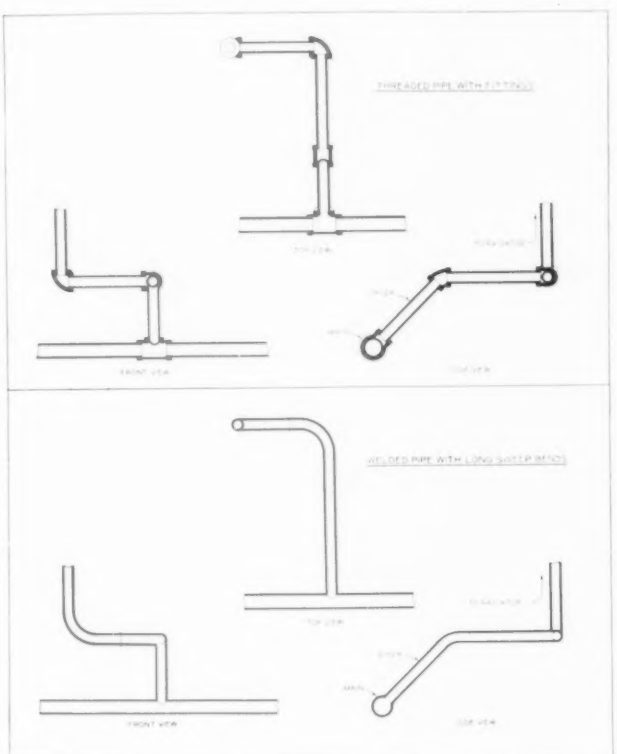


Fig. 5. Threaded Connections (Above) and Corresponding Welded Connections (Below).

nothing to retard the progress of steam to the radiator. In the threaded-fitting threaded-pipe views shown at the top, four threaded fittings are necessary to complete the pipe run from the main to the radiator; while in the welded fabrication, only two joints are necessary, the weld on the riser and one pipe weld as shown.

Because of the importance of insulation to a heating installation, blueprints of Figures 1 and 3 were submitted to a large national company who specializes in insulation materials for bids on cost of insulation material. Their

heating engineers recommended that an 85% magnesia material be used and quoted a figure of $243.24 for material cost of 499 ft. of straight insulation and 178 fitting joints for the threaded fittings and threaded pipe fabrication as shown on Figure 1. They then quoted a figure of $228.43 for 501 ft. of straight insulation and 138 fitting joints for the welded long sweep bend fabrication as shown on Figure 3.

While the estimate for insulating the welded long sweep bend fabrication was $14.81 lower than the estimate for the threaded-fitting threaded-pipe fabrication, this does not show the entire saving that can be had, because the cost of labor is not included.

Figure 6 clearly indicates where the real saving is made. On the threaded-fitting threaded-pipe fabrication

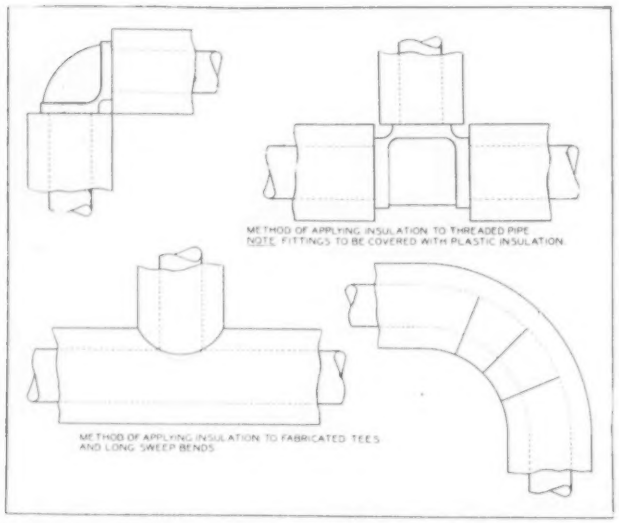

METHOD OF APPLYING INSULATION TO THREADED PIPE
NOTE FITTINGS TO BE COVERED WITH PLASTIC INSULATION.
METHOD OF APPLYING INSULATION TO FABRICATED TEES
AND LONG SWEEP BENDS

Fig. 6. Welded Tees and Bends Simplify the Application of Insulation.

there are 178 joints that make it necessary to stop the straight insulation forms at the threaded fittings. In the case of an elbow, the straight forms stop on both sides and the threaded elbow is then covered by plastic insulation and molded to the same size as the straight forms and then covered. In the case of a threaded tee and threaded pipe, straight insulation is brought up to the three sides of the tee and plastic insulation is molded to the same size as the straight forms and covered. This molding operation consumes much time that does not show in the estimate of insulation costs but must be taken into consideration.

Less Hand-Molded Insulation on Welded System

On the welded, long sweep bend fabrication it was estimated that there were only 138 joints that required plastic insulation operations and then only on the pipe bends of the smallest-size pipe, and that 50% of these joints could be efficiently insulated by cutting out sections from the sides of straight forms, then drawn up, cemented and covered as also shown on Figure 6.

On all welded connections requiring a tee, straight forms can be used exclusively, eliminating plastic insulation, by cutting a hole in the top of one straight form and cutting the end of another straight form to fit (also shown on Figure 6). All these insulation savings are possible only on piping installations of welding and cutting fabrication.

Iowa and Ohio Universities to Hold Welding Conferences

The fifth welding conference of Iowa State College will be held at Ames, Iowa, January 18th to 20th. The Ohio State University will hold its second annual welding conference in the Industrial Engineering building on the university grounds in Columbus, Ohio, February 23rd and 24th. The program at Iowa State College includes talks and demonstrations on arc and gas welding and cutting and metal spraying. A feature will be the testing of welds made by those in attendance at the conference. Further information regarding the Iowa conference can be obtained from D. C. Faber, Director Engineering Extension Service, Iowa State College, Ames, Iowa, and information regarding the Ohio conference can be obtained by writing O. D. Rickly, Director of Engineering Shops, The Ohio State University, Columbus, Ohio.

I.A.A. 1933 Convention Visitors Will See "A Century of Progress"

Next year's convention of the International Acetylene Association will be held in Chicago during the last week in September. The reason for deviating from the usual November date is to enable the convention visitors to see A Century of Progress before the Exposition closes its doors on the last day of October.

Tentative Specifications for Welded Pipe and Boiler Tubes

Electric-fusion-welded steel pipe (8 in. to but not including 30 in.) and lap-welded steel and iron boiler tubes and seamless steel boiler tubes are covered in two sets of tentative specifications recently published by the American Society for Testing Materials. The Society invites criticism and suggestions based on these tentative specifications, and these should be directed to H. P. Bigler, Rail Steel Bar Association, 228 N. LaSalle St., Chicago, Ill.

These specifications pertain to the process of manufacture, chemical and physical properties and tests, weights and dimensions, workmanship and finish, marking, and inspection and rejection. Copies may be obtained from the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa.

Steel Floors Approved for Philadelphia

The Bureau of Buildings of Philadelphia on September 15th granted its approval for the use of steel floors in Class 1 buildings. This is the first major city to extend such recognition to this improved method of building and it should be of great assistance in obtaining similar approvals in other large cities, says the November issue of *The Steel Constructor*. This marks an important future development in the use of steel floors in major buildings, especially as it includes the use of steel floors as horizontal stiffening members in wind-braced buildings, provided that the connections between floor units and between floor panels and beams and girders are sufficient to develop the full horizontal shear.

Production Is Stepped Up and Assembly Costs Are Cut by

Brazing With Low-Melting-Point Alloys

By R. R. Shuman

WORKERS in non-ferrous metals now have available for their use strong but inexpensive brazing materials with a much lower melting point than that of spelter, brass, bronze or other brazing or welding alloys. These new brazing alloys are finding acceptance in a variety of industries.

One of the most important uses of Sil-Fos, which is such a brazing alloy as described above, is in the electrical refrigerator industry, notably for brazing the joints and connections between copper piping and the brass condenser reservoir (see Fig. 1). Such joints must be strong, leak-tight, enduring and corrosion resisting.

Builders of electrical transformers are finding it ideal for brazing taps, leads and other copper conductors because it flows at 1300° F., which is several hundred degrees lower than the commercial welding alloys formerly used, at the same time offering an extremely high factor of strength and good electrical conductivity. The fact that no flux was found to be necessary in brazing copper conductors facilitated quick work, especially where the conductors were assembled in close quarters. A case was cited in which a 50,000-kw. condenser was repaired by its owner with Sil-Fos at a cost of only 10% of that estimated by engineers figuring on old methods. Sil-Fos is also widely used in brazing rotor-bars to end-rings in "squirrel cage" motors.

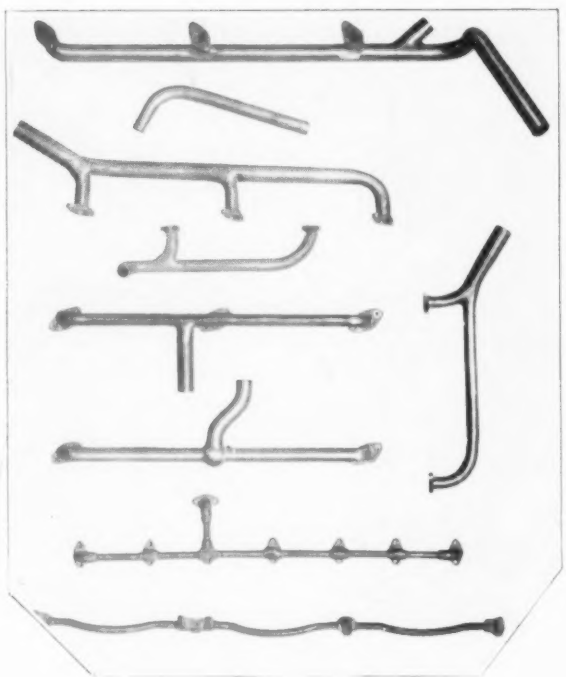


Fig. 2. Pipe Lines for Automobile and Marine Engines Have Brazed Joints to Insure Against Leaks and to Withstand Heat.

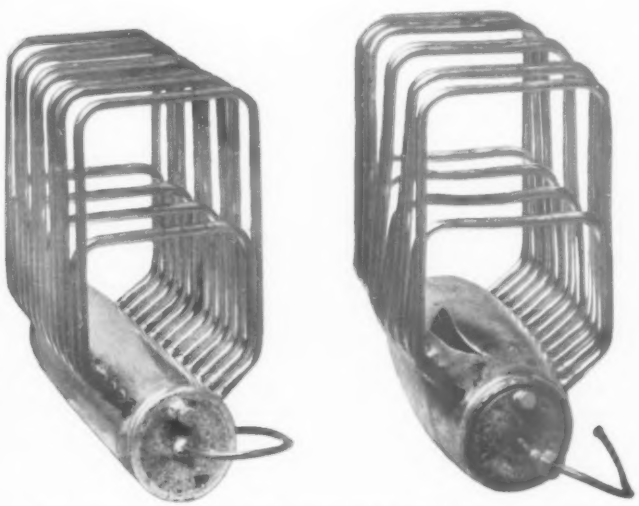


Fig. 1. Brazed Evaporator Coil Before and After Bursting at 1300 Lb. Hydraulic Pressure in Destruction Test.

(The drawn-brass cylinder was bellied out by the high internal pressure, and the flat-ribbed ⅝-in. forged brass head was "dished" outwardly. Yet not a drop of water issued from any one of the 29 Sil-Fos brazed joints in the assembly. These units are regularly inspected for leaks by applying air pressure internally and immersing in water. It is claimed that the number of assemblies showing even the slightest evidence of a leak does not exceed 1%. This unit is being used on a well-known make of refrigerator.)

Another industry where this alloy is doing good work is in the brazing of fuel and oil lines in automobile and truck motors (see Fig. 2). One manufacturer reported the average brazing time on 11 joints in oil manifolds for a well-known motor truck engine at 35 seconds per joint. This assembly consists of brass tees, ells, and crosses, brazed to ⅝-in. copper tubing 3 ft. long. The remarkably free-flowing and quick-setting properties of this brazing alloy were reported by this user as cutting his brazing time in two, compared with the brazing metal formerly used.

Butt-welded tubing sometimes splits during fabrication. These defects are being mended successfully with Sil-Fos brazing alloy. As a rule no flux is found necessary on copper tubing, though its use is advisable on brass. One outstanding advantage claimed for this alloy for this

work is that its low melting temperature avoids the risk of injuring the tubing adjacent to the weld. Another is the speed with which the repair work can be done, and consequent low labor cost. A third is the fact that only an extremely thin film of the alloy does the work, making neat, almost invisible joints.

Sand holes, blow-holes and other defects in non-ferrous castings are quickly corrected. An interesting case in point is the red brass buck of a necktie pressing machine (see Fig. 3). The brass is cast over a V-bent steel pipe, and no way has yet been found to prevent the formation of a multitude of blow-holes in the casting where the molten metal strikes the cold pipe. These holes are now filled with Sil-Fos. The whole casting is heated to about 1400° F. and the Sil-Fos and flux are applied to each hole in turn. It penetrates instantly, taking such good hold of the metal that it does not pull out when the surface is smoothed off with a heavy rasp. Plating follows, and the nickel was reported as adhering to the Sil-Fos quite as perfectly as to the brass.

Copper has so high a heat-conductivity factor that it is difficult to hold the heat of heavy sections of copper at a welding temperature sufficiently high to braze with bronze or spelter. Even the melting temperature of borax flux (1400° F.) presents a problem on extra-heavy copper work. This was the problem that confronted a Philadelphia coppersmith in brazing the 5/8-in.-thick rolled copper water jacket to the 3/4-in.-thick body of a 5-ton copper still. As the inside diameter of this 10-ton vessel was 6 ft., the seam to be brazed was more than 18 ft. in circumference—a real problem; but Sil-Fos solved it because it flowed at 1300° F. and did not require the use of flux in brazing the copper surfaces. Fig. 4 illustrates one of these vessels.

Fig. 4. Copper Still With Brazed Joint Between Water Jacket and Body.

(The brazed seam is more than 18 ft. long. The vessel is 6 ft. in diameter and weighs 5 tons. Sil-Fos was used for brazing.)

Going to the other extreme, a low-temperature alloy is being used in brazing delicate parts of instruments, such as temperature regulators, gages, etc. Its low melting

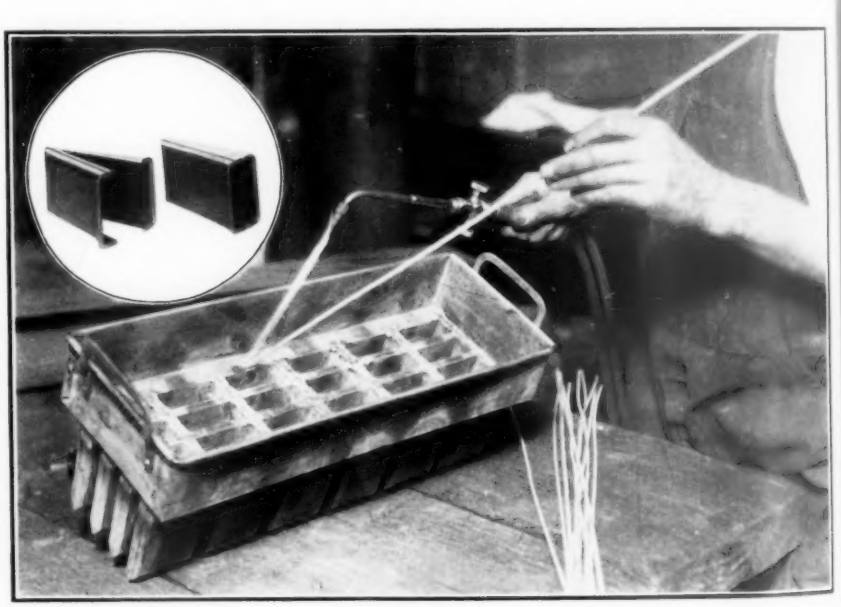


Fig. 5. Soda-Water Freezing Tray Assembled by Brazing.

(Made of 28-gauge copper, this tray contains 24 pockets which are brazed at the side seams, as shown in circular insert, and then brazed into the framework. The 434 lineal inches of brazing in each tray is accomplished in 90 minutes. No flux was required.)

Fig. 3. Bronze Castings of Buck of Necktie Press.

(Right-hand view shows casting after drilling out air holes, and in the other view these pits are filled with brazing alloy to make a smooth surface. Overall length, 24 in.; weight, 7 lb.)

point offers the advantage of preventing the impairment of delicate parts contiguous to the weld; while its extreme fluidity permits making neat, almost invisible joints. This applies also to brazing the studs on the backs of enameled campaign buttons, badges, etc. where temperatures dare not be high enough to impair the enamel.

Another application of such alloys is for the brazing not only of brass, bronze, extruded brass and bronze, but also of nickel, nickel-silver, monel metal and other non-ferrous metals. A Chicago apparatus manufacturer uses Sil-Fos in brazing expansion joints in pure nickel coils for cooking utensils for food factories. These coils run as large as 2½ in. outside diameter, and each coil weighs about 150 lb.

A multiple mold for freezing "soda water on a stick" is made from 28-gage copper sheets. A mold has 24 pockets, each of which is first brazed down a side-seam, then brazed into the copper bed of the mold. Quantity

Fig. 6. Brazing Ends of Fuel Lines in Gas Stoves.

production at low unit cost was facilitated by a low-melting point brazing alloy and the fact that no flux was necessary. It is also interesting to note that these molds, in use, are subjected to 90° below zero temperature, after which they are immediately immersed in a boiling brine. Expansion stresses thus set up must be great; yet the brazed joints proved to have the strength and ductility to withstand this operation, which is repeated many times. Fig. 5 shows one of these molds.

Cutting and welding torches are continually getting out of order, due usually to abuse by their users. A free-flowing brazing alloy is found to be ideal for torch repair work. With a 1300° flow point, this alloy is available for repairing joints originally made with higher-melting-point alloys.

Pig tails for liquid or compressed-gas drums are brazed both in manufacture and repair operations. The homogeneity of joints made with a low-melting-point brazing alloy contributes to leak-tightness, even under extremely high pressures.

Strength and ductility need not be sacrificed when using low-fusing-point brazing alloys. Copper-to-copper lap joints are said to test 33,000 lb. per sq. in. and stand hammering or extreme reduction in rolling.

The alloy will penetrate minute openings into which the more sluggish all-base-metal alloys will not flow. This characteristic also permits joining metal surfaces in such tight contact that the joints show a mere hair-line—contributing to neat, almost invisible joints. So simple is the application that some users employ inexpensive labor instead of trained welders, to do the work.

Second Annual Welding Exposition Held in Minneapolis

The Second Annual Exposition on Welding and Heat Treating was conducted by the North West Chapter, American Society for Steel Treating, and the Manufacturers' Association of Minneapolis, Inc., on December 1st to 3rd, at the plant of the Caterpillar Tractor Company, 2501 University Ave. S. E., Minneapolis, Minn. The exposition this year was enlarged by including exhibits and demonstrations of heat treatment of steel and non-ferrous metals.

The exposition was wholly educational in character, and no admittance fee was charged. The program of papers presented was prepared with particular consideration to the needs of the practical men who are performing welding and heat-treating operations. The papers touched upon a variety of subjects, such as the following: "Welding Rods," by Stuart Plumley, Smith Welding Equipment Corporation; "Experiments With Liquid Air," by G. W. Irwin, Air Reduction Sales Company; "Restoration and Maintenance of Plant Equipment," by F. G. Outcalt, Linde Air Products Company; "Steel and its Heat Treatment," by W. I. Sweet, Twin City Steel Treating Company; and "Electric Arc Welding," by J. E. Colbert, Westinghouse Electric & Manufacturing Company.

Demonstrations were shown of the welding of bronze, aluminum, malleable iron, steel, and chromium alloys; and of pipe welding, electric arc and spot welding, heat treating, annealing, temperature control, hard surfacing, etc. Exhibits of various types of welded and heat-treated products were shown. Motion pictures were used in some of the displays. The demonstrating exhibitors were limited to those who have their plant or a factory branch in Minneapolis.

About 2500 were in attendance at the exposition. Many visitors were present from surrounding states. The high interest shown will probably result in making the exposition an annual event.

Welded Machine Parts Discussed by Australian Institute

At the monthly meeting of the Australian Welding Institute held at the Working Men's College in Melbourne on the evening of November 22nd, the following talks relating to "Welded Machine Parts" were given: "Design of Castings and Design of Welding," by E. Lang; "Welded Work Overseas," by C. A. Masterson; and "Welded Work in Australia," by J. Hunter. The meeting closed with a commentary on these lectures by Prof. W. N. Kernot.

Survey Reveals Opinions on the Question:

What Related Subjects Should Be Taught Cutters and Welders ?

LAST winter a survey, based on answers to a questionnaire, was made by A. G. Odell, director of welding instruction, Denver Opportunity Public School, to obtain opinions on what related subjects or knowledge thereof should be taught in the training of welders, cutters, and others interested in the welding or cutting processes. Such information, it was thought, would be of assistance in establishing a system of instruction in related subjects that could be used in public and private educational institutions, in trade schools, and in the welding industry, and that would meet the approval of boards for vocational education, of industry, and of manufacturers of equipment and supplies.

To obtain information for the development and completion of this survey so the question might be viewed from its broadest aspects, 192 questionnaires were mailed to various groups. Fifty answers were received, 40 of which were returned questionnaires that had been filled out and 10 were letters. These 40 questionnaires were divided as follows: from manufacturers of equipment, 12; manufacturers of supplies, 7; universities, colleges and schools, 6; consulting engineers, 2; trade magazines, 2; and users of welding processes, 11.

Rating	Chemistry	Metallurgy	Metallography	Physics	Crystallography	Heat treat'g	Sheet metal layout	Pipe layout	Blue print read'g	Welding theory	Cost estimating
1st	1	3	1	0	0	0	1	0	3	12	0
2nd	0	4	3	3	0	3	2	2	5	2	0
3rd	1	4	1	1	0	4	3	1	4	1	1
4th	1	2	3	4	0	6	2	3	1	1	2
5th	3	0	3	1	1	5	2	3	2	2	1
6th	0	2	0	4	1	2	2	0	1	1	6
7th	3	3	4	1	0	0	3	1	1	1	0
8th	0	2	2	3	1	1	2	3	2	0	1
9th	5	1	0	1	2	0	2	3	1	0	1
10th	3	0	2	2	5	0	1	2	1	0	1
11th	0	0	0	0	5	0	0	0	0	0	6
None	23	19	21	20	25	19	20	21	19	19	21

Table 1. Order of Importance of Related Subjects to Be Taught Welders and Cutters.

(Example: Welding Theory was 1st choice in 12 replies, 2nd choice in 2 replies, etc., while 19 replies expressed no preference. Heat Treating received no votes for 1st place, but was 2nd choice in 3 replies, etc.)

Class of Employee	Chemistry	Metallurgy	Metallography	Physics	Crystallography	Heat treating	Sheet metal layout	Pipe layout	Blueprint reading	Welding theory	Cost estimating
Welders and Cutters	30	32	28	31	25	27	32	33	36	35	32
Engineers	29	27	28	29	23	27	32	26	27	30	28
Foremen	13	16	12	11	9	12	15	20	26	26	18
Purchasing Agents	9	11	8	9	6	8	8	8	13	18	16
Demonstrators	12	16	13	14	8	12	15	16	21	24	11
Instructors	22	24	23	20	18	26	23	22	25	27	11
Supervisors	7	14	10	10	6	20	19	20	22	33	12
Applied Servicing Engineers	14	15	12	17	11	21	18	20	22	22	14
Draftsmen	7	11	9	13	4	11	25	25	24	24	17
Superintendents	15	19	18	19	14	21	19	19	23	26	19
Inspectors	14	19	15	15	11	23	22	22	23	24	9
Salesmen	12	14	11	14	8	15	12	13	18	20	15
Testers	12	15	15	14	9	16	11	12	19	25	4
Directors of Welding and Cutting	26	28	28	28	25	26	28	26	26	29	17
Oxygen and Acetylene Plant Employees	13	3	2	8	2	7	5	6	9	15	2

Table 2. Value of Related Subjects to Various Classes of Employees Concerned With Welding.

(Example: Of the number replying to the questionnaire, 14 were of the opinion that Inspectors should be trained in Chemistry, 19 said they should be trained in Metallurgy, etc.)

Table 1 gives the results of the questionnaire as they pertain to the relative importance, or rating, of the eleven different subjects listed at the top of the table. It will be noted that out of 21 who expressed their preferences, 12 placed welding theory first, and the next most important subjects were blueprint reading and metallurgy. It is interesting to note in the original report itself that 3 out of 12 manufacturers of equipment expressed their preferences in this matter and all three placed welding theory first. Likewise, 4 out of 5 expressions from manufacturers of supplies gave first place to welding theory, as did also 3 out of 6 users of the welding processes. In replies from schools, however, only 1 out of 5 voted first place to welding theory, while 2 placed first emphasis on metallurgy.

Table 2 gives the results of a questionnaire inquiring what subjects should be taught to welders and cutters, without any regard to the relative importance of the subjects, as well as to other employees who are directly or indirectly connected with welding. Without going into an analysis of this table, mention will merely be made that it reveals a great deal of fundamental information. For example, it shows the evident fact that oxygen and acetylene plant employees should receive training in chemistry rather than metallurgy, but that

Classes Answering Questionnaire	Would welders and cutters qualify more readily if trained in theory?		Should welders and cutters be licensed?		Should schools giving welding instruction be licensed?		Should instructors in practical instruction be licensed?	
	Yes	No	Yes	No	Yes	No	Yes	No
Mfgrs. of equipment	10	2	2	8	3	7	2	6
Mfgrs. of supplies	7	—	3	4	3	3	2	3
Educational institutions	5	1	5	—	2	3	3	—
Consulting engineers	1	1	1	—	1	1	—	—
Trade magazines	1	1	—	2	—	2	—	2
Users of welding	6	4	5	5	6	5	4	5
Total	30	9	16	19	15	21	11	18

Table 3. Replies to Questions Regarding Value of Theory, and Whether Welders, Instructors, and Schools Should Be Licensed.

draftsmen and inspectors will receive more value from a study of metallurgy than of chemistry.

The replies on four questions, three of which pertain to licenses, are given in Table 3, these being grouped according to the six classes to whom questionnaires were sent. It is of interest that manufacturers and schools say "Yes" almost unanimously to the question "Would welders qualify more readily if trained in theory?" while of the users of welding 6 say "Yes" and 4 "No". In the matter of licenses for welders, instructors, and schools, the manufacturers of equipment show a great amount of opposition to the license system, while the manufacturers of supplies and users of welding are more evenly divided on the question; schools, on the other hand, are for the licensing of welders and instructors but show some opposition to the suggestion that the schools themselves be licensed.

The question "Why is there not more theory or related subjects taught?" brought many replies, typical of which are: "The value of related theory and subjects is not understood or realized." "Lack of time." "No theory has been studied by many school instructors." "Nobody to teach in the language of those to receive the teaching."

A very wide diversity of opinion is shown regarding the desirable qualifications of instructors in related subjects. In regard to a textbook of instruction, all expressing their views said "Yes", and many of these made specific recommendations.

High Interest in Welding Shown at Purdue Conference

With a total registration of 252, the eighth annual conference on welding held at Purdue University, Lafayette, Ind., closed on December 9th after a two-days' program devoted to papers and demonstrations. The conference was held under the direction of the Engineering Extension Department, of which Prof. W. A. Knapp is in charge, and the Department of Practical Mechanics, headed by Prof. J. D. Hoffman. Professors Knapp and Hoffman presided at all sessions.

A very large crowd was present at the evening session on December 8th, at which two very interesting demonstrations were given—one on metal spraying by L. E. Kunkler, of the Metallizing Company of America, and the other on the determination of stress concentrations in simple welded joints by means of polarized light and transparent models, given by S. C. Hollister, professor of structural engineering, Purdue University.

Present developments in structural welding were reviewed by E. W. P. Smith, consulting engineer, The Lincoln Electric Company. A paper by E. D. Wright, operating manager, Graver Tank & Manufacturing Corporation, discussed methods used in the field welding of tanks, with particular reference to the most modern practices and probable future trends.

In a paper on "Machine Cutting With Gas", R. F. Helmcamp, of the Air Reduction Sales Company, laid particular emphasis on the use of the oxyacetylene flame in deseaming operations and other types of flame machining.

Modern practices in resistance welding were outlined in a paper by M. L. Eckman, of The Federal Machine & Welder Company. Many applications of flash, spot, and seam welding to automobile bodies were described by E. B. Rausch, supervisor of welding of body plant, Studebaker Corporation.

A new type of automatic welding head for use with heavily coated electrodes was described in a paper by H. O. Westendarp, Jr., of the General Electric Company.

"Welding for Maintenance and Plant Rehabilitation" was the title of a paper by F. G. Outcalt, development engineer, The Linde Air Products Company. Safety practices in the handling and use of compressed fuel gases was the subject of a talk by E. E. Evleth, engineer, The Bastian-Blessing Company. H. H. Lurie, research engineer, Claude S. Gordon Company, summarized the results of an investigation conducted for more than three years at Purdue University into the possibilities in the use of illuminating gases for welding.

A number of developments in the year 1932 having an important bearing on the welding field were described by F. L. Spangler, managing editor, *The Welding Engineer*, at the opening of the conference. The opening talk at these conferences has heretofore been given by H. S. Card, editor, *The Welding Engineer*, who sent his regrets that he could not be present this year.

Several manufacturers exhibited at the conference and gave demonstrations of cutting cast iron, bronze welding, applying hard-surface metals, welding aluminum, pipe cutting and beveling, testing of welds for tensile strength, brazing, and soldering.

St. Louis Welding Society Seeks Revision of Building Code

A revision of the St. Louis building code to permit fusion welding of steel structures is being agitated by the St. Louis Welding Society. In this connection, welded steel samples from 32 St. Louis industrial plants were tested in the 40-ton tensile testing machine at the St. Louis Testing Laboratory, 2317 Chouteau Avenue, on October 28th, at a regular meeting of the society. The average ultimate tensile strength of the specimens was 56,936 lb. per sq. in., with 28.9% average elongation. Code revision came up for discussion at the meeting of the society on November 25th, at which motion pictures of recent welded steel constructed dwellings were shown.

The new officers of the society are: President, E. P. Barnes, Maloney Electric Company; vice-president, R. G. Ellis, American Car & Foundry Company; secretary-treasurer, R. P. Hartnett, Arcade Welding Service; and directors, A. V. Fausek, Modern Engineering Company; B. N. Osmin, Hill Equipment Engineering Company; M. E. Meyerson, St. Louis Testing Laboratory; W. A. Talkacz, Missouri Boiler Company; A. H. Wilson, St. Louis Public Service Company; and W. T. Wills, Maloney Electric Company.

Program of Institution of Welding Engineers

A paper on "The Essentials of Good Welding," by A. G. Walker, is scheduled for the December 21st meeting of the Institution of Welding Engineers, London. At the January 18th meeting C. Helsby will speak on "Welding in Civil Engineering". The Birmingham Branch, which holds its meetings at the Chamber of Commerce, will hear a paper on "Welding Cast Iron and Ferrous Alloys," by J. G. Pearce, on January 20th. At the meeting of the Birmingham Branch to be held in the College of Technology on January 25th, A. G. Walker presents a paper on "The Essentials of Good Welding."

Welding of Pipe and Non-Ferrous Metals Considered at Los Angeles A. W. S. Meeting

"Welding of Industrial Piping" was the subject of a talk scheduled for the December 15th meeting of the Los Angeles Section, American Welding Society. The speaker was G. T. Brooke, manager Industrial Division, Crane Company, who used motion pictures and slides to illustrate the talk. A number of large pipe manufacturers and users and piping contractors were represented and engaged in a profitable discussion following Mr. Brooke's address. At the meeting of the Section held on November 17th, a highly interesting talk on "Welding Aluminum and Aluminum Alloys" was given by J. R. Schmidgall, sales engineer for the Aluminum Company of America. Another feature of this meeting was a talk by G. T. Piersol, sales engineer for the American Brass Company, on "Welding Brass, Bronze and Their Alloys."

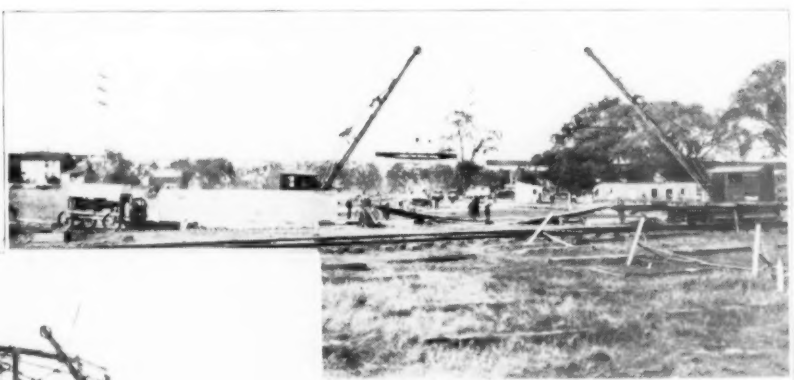
Welder Training and Aluminum Welding Are Subjects at Chicago Meeting

The meeting of the Chicago Section, American Welding Society, held on December 16th, was featured by four scheduled talks—all of considerable importance to the members of this section. J. I. Banash, consulting engineer, gave a report on the status of the proposed new Chicago building code, with particular attention given to the recent public hearing on the section of the code permitting the use of welding in steel structures.

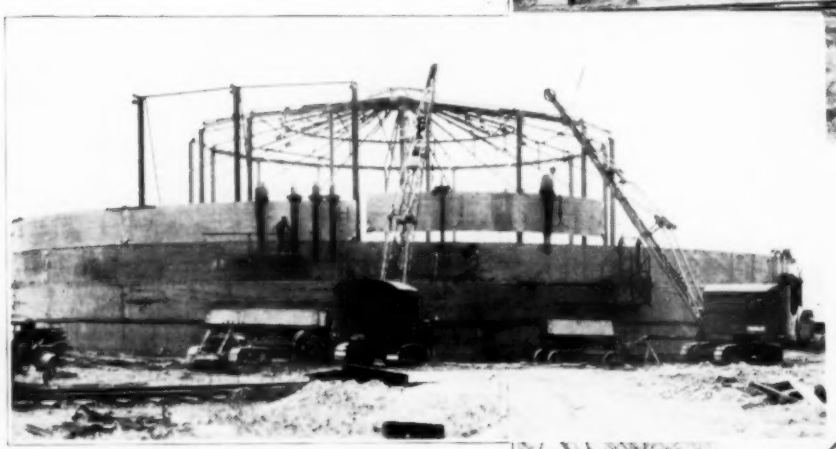
Motion pictures and slides were used by G. O. Hoglund, who is in charge of welding at the U. S. Aluminum Company, New Kensington, Pa., in a talk on the welding of aluminum and its alloys. The training of welders and inspectors, with particular reference to the methods employed by the Commonwealth Edison Company, was described by J. S. Strong and J. F. Sullivan, Jr.

Erecting and Welding Huge Water Storage Tank

(View of completed tank is shown on front cover of this issue.)



Start of erection of 6,000,000 - gallon tank by A. O. Smith Corporation for city of Milwaukee at southwest limits of city. The bottom steel plates, $\frac{3}{8}$ inch thick, weigh two tons each and are laid on a bed of concrete and asphalt.



The bottom side plates $1\frac{1}{4}$ inches thick, weigh four tons each and are welded to the floor plates. These side plates are six feet high and taper off in thickness as they are stacked one on top of the other and beaded inside and out.

The completed tank is 165 feet in diameter and 40 feet high, with no supporting members whatever inside. P & H Hansen gasoline - driven arc welders were used in the welding of this tank, and P & H crawler cranes set the plates in place.

What effect has the carbon content of an electrode on weld penetration? Why are some gas rods "copper coated" and some electrodes lime coated? What elements in the rod increase the strength of the weld metal? Why does a "shielded arc" result in increased weld strength? What is the analysis of rods used for bronze welding? Why is not electrolytic copper as easy to weld as the deoxidized metal? Mr. Plumley answers these questions in the following article on—

Paper presented at the Second Annual Exposition on Welding and Heat Treating, Minneapolis, Minn., Dec. 1-3, 1932

Selecting and Using Welding Rods

By Stuart Plumley
Chief Engineer, Smith Welding Equipment Corporation

THE subject of welding rods is a very broad one; and to give it even ordinary consideration, it is necessary to classify these rods into various divisions and subdivisions. These divisions would naturally be two in number, one covering "ferrous" and the other "non-ferrous" rods.

The ferrous division would normally include several subdivisions; for instance, low-carbon rods for gas welding, low-carbon rods for electric welding, medium-carbon rods for electric welding, high-carbon rods for gas welding, high-carbon rods for electric welding, alloy steel rods for gas and electric welding, etc.

The non-ferrous division would naturally fall into such subdivisions as Tobin Bronze rods, manganese bronze rods, silicon bronze rods, these being used principally in connection with gas welding; phosphor bronze rods for electric welding; deoxidized copper rods for both gas and electric welding; monel metal rods for both gas and electric welding; Everdur rods, Herculoy rods, and many other special alloys.

It is, of course, impossible that we should consider all of these subdivisions this afternoon. At the Dunwoody Industrial Institute I have a class in Welding Engineering. This course of instruction includes fourteen lessons of two hours each, or twenty-eight hours, upon welding rods, and the subject is by no means exhausted in this period of time.

To me welding rods are the most important items which the welder now has to consider. The extended use of new metals and alloys in all classes of construction has made it necessary for the welder to possess a greater knowledge of metals if he is to be successful under modern welding conditions.

It should be understood that in these classifications of welding rods, I have not included any hard-surfacing metals. The subject of hard alloy overlays, or hard-surfacing metals, is a subject by itself and should be dealt with separately. In this paper I will make no attempt to discuss it in any way.

There are so many welding rods upon the market today, both for gas and electric welding, that the welder in many cases is utterly bewildered to know what rods to use in a particular instance.

It is my belief that there is only one way out for the average welder, and that is to begin a very careful and thorough study of metals and of welding rods and their application in a generally similar manner to the instruction being given at the Dunwoody Institute in connection with the course in Welding Engineering. In other words, to continue to be successful, the welder must vastly improve his knowledge of the characteristics of metals and the analyses and other characteristics of welding rods to be able to produce the best results in general welding.

It is true that many welders will state that they are told by their foreman or engineers to use rods upon certain work and that, therefore, there is no necessity for their having an intimate knowledge of these matters. While this may be true upon the railroads, or in large mechanical shops, there are thousands of welders who are so located that they must decide these things for themselves. They have not an engineer available, or perhaps the engineer who is in charge of the work is not familiar with the subject.

Low-Carbon Gas Rods

Let us consider, first, low-carbon rods for gas welding. This is a relatively simple subdivision because these rods are readily available and practically all of them con-

form to the specification, G No. 1A of the American Welding Society. This specification calls for an analysis as follows:

Carbon	Not over 0.06 of 1%
Manganese	Not over 0.15 of 1%
Phosphorus	Not over 0.04 of 1%
Sulphur	Not over 0.04 of 1%
Silicon	Not over 0.08 of 1%

These rods are usually furnished in the liquor-bright finish, and are commonly called by the trade "copper-coated rods." These rods are not really copper coated, because if they were coated with any amount of copper the resultant weld would be highly unsatisfactory. They have, however, a bright copper-colored, chemically clean surface, and this is what is desired for gas welding. This surface is a result of one of the final processes in wire drawing. It is called "wet-drawing" and consists in dipping the wire, before finally drawn, in a solution of copper sulphate (blue vitriol) dissolved in water to which a small percentage of sulphuric acid has been added. The wire is drawn wet with this solution and the result is the bright copper finish with which we are all familiar. With such rods a weld may be made with the torch, having a strength of about 50,000 lbs. per sq. in. or somewhat less.

For many purposes this type of rod is entirely satisfactory, and where a weld may be reinforced, that is, the weld metal section built heavier or thicker than the plate, sufficient strength can be developed for all ordinary purposes.

Such rods may be used for the welding of mild-steel plate, but would be utterly unsuitable for the welding of higher-carbon grades of pipe required for high-pressure steam, oil or gas service. They would also be unsuitable for boiler work covered by the specifications of the boiler code of the American Society of Mechanical Engineers; for such work a high-strength rod must be used, which is usually an alloy steel rod if it is to be used for gas welding.

Electrodes for Welding Mild Steel

Now let us consider the same general class of rods for electric welding. A very different situation develops when electric welding is considered. The liquor-bright finish, which is so advantageous for gas welding, is not suitable at all for electric welding. A bare low-carbon electrode is shorter than the welding rod used for gas welding; and instead of the liquor-bright copper finish, it has a residue left upon its surface consisting principally of lime which has accumulated upon the rod during the wire-drawing process.

This lime coating is very thin and there is apparently little of it left upon the surface of the rod, but it is essential to the proper operation of the arc. The coating steadies the arc, as does also a sull, or rust coating, which is likewise used for bare electrodes.

Many welders have the idea that there is a radical difference between the steel used in welding rods for gas welding and that used for bare electrodes for electric welding. The difference in the steel may be one only of carbon content. The radical difference does not lie in the steel itself, but in the finish of the rod. For gas welding, the chemically clean finish is desired and is most successful, but for electric welding the thin lime coating, due to the dry wire-drawing process, is essential to prevent wildness of the arc.

Low-carbon electrodes may have a carbon content of 0.06%, which would be equivalent to the E No. 1A specification of the American Welding Society, or they may have a carbon content of 0.13% to 0.18% and in this case would be in accord with the specification E No. 1B of the American Welding Society.

Obtaining High-Strength Welds

If the gas welder desires to make a stronger weld than can be obtained with the usual low-carbon welding rods, he obtains an alloy welding rod having a bare, bright surface, but not necessarily a copper-bright finish. This alloy rod will contain perhaps nickel and chromium with a higher percentage of carbon, or perhaps merely a higher percentage of carbon and some vanadium. For instance, the analysis of a very good high-strength rod is:

Carbon	0.25%
Manganese	0.40%
Silicon	0.25%
Chromium	0.25%
Nickel	1.50%

Another excellent rod contains:

Carbon	0.20%
Manganese	0.80%
Silicon	0.55%

or the rod may be nickel-steel rod having an analysis equivalent to the specification of the American Welding Society for nickel-steel. This would be:

Carbon	0.15 to 0.25%
Manganese	0.50 to 0.80%
Phosphorus	0.04% max.
Sulphur	0.04% max.
Nickel	3.25 to 3.75%

Any of these rods will produce welds having considerably higher strength than 50,000 lbs., the maximum which would normally be expected of the low-carbon rod. The weld metal of some welds made with these alloy rods and the gas torch may have a strength of 60,000 lbs. or even more, depending, of course, upon the work being done and the skill of the welder.

The strength of the weld metal is, to a considerable extent, due to its carbon content. The carbon content of the weld metal is usually lower than that of the welding rod which has been used in connection with the oxyacetylene torch.

This difference in oxyacetylene welding is, however, nothing like as great as it is in electric welding when bare electrodes are used. For instance, the specifications of the American Welding Society do not consider that there is a great difference between the rods covered by the E No. 1A specification and containing 0.06% of carbon, or those covered by the E No. 1B specification containing 0.13% to 0.18% of carbon, insofar as the weld metal is concerned. The reason for this is the fact that a large proportion of the carbon is consumed during the passage of the metal through the arc, with the result that the weld metal does not contain very much carbon, whether the lower or the higher percentage is used in the electrode.

The analysis of a typical deposit made with a bare electrode might be as follows:

Carbon	0.05%
Manganese	0.11%
Phosphorus	0.02%
Sulphur	0.11%
Silicon	0.07%

When an electric welder, therefore, desires to produce a weld having a higher strength than the typical deposit from a bare low-carbon rod, he does not turn to a slightly higher carbon or alloy rod, but he obtains a coated or covered electrode, in the operation of which the carbon passes through the arc protected by the coating or covering, or the gases produced by it, and becomes a part of the weld metal, which is much higher in carbon and, therefore, greater in strength than the deposit produced by the bare electrode. Of course, all of the carbon in the electrodes does not pass through the arc stream, but a large proportion of it does and also a much larger proportion of the manganese and silicon contents of the rod. Both of these assist in deoxidizing the metal, with the result that the weld metal is dense, strong and ductile.

Covered Electrodes

The weld metal of a covered electrode may have approximately the same analysis as the E No. 1B of the American Welding Society containing 0.13 to 0.18% of carbon, and yet produce a weld much higher in tensile strength, ranging above 60,000 lbs. per sq. in. when properly applied.

The coating may vary from a processed electrode having a light coat to the very heavily covered electrode used in what is known as shielded-arc welding. But whatever the nature of the coating, the object is to transfer through the arc stream the elements in the electrode with as little loss as possible, and to prevent through the production of non-oxidizing gases around the arc stream the contact of these elements with the oxygen of the air. A further object is to cover the completed weld with a protective coating or covering to prevent oxidation and to assist in slow cooling. Sometimes various metallic elements are included in the coating to increase the content of these elements in the weld metal.

The possibilities of the coated electrode seem to be almost unlimited, and it is my belief that such electrodes will be used to a constantly increasing extent as their advantages are better understood by the average welder.

It is not my intention to discuss in detail the hundreds of coated and uncoated electrodes and other welding rods now upon the market, but rather to attempt to convey to the welder and the welding engineer the importance of definite knowledge of the chemical analysis, as well as the physical characteristics, of the welding rods which he uses.

There is a growing tendency on the part of the manufacturer and the seller of welding rods to state the chemical analysis of the rod in his literature. If he does not want to give the complete analysis of the rod, he at least can indicate the limits of the carbon content. If this is done, the consumer of the rod, or the engineer, soon begins to associate with the trade-name under which the rod is sold a knowledge of the approximate analysis of the rod and he can, under these conditions, utilize the rod to very much greater advantage than if he knows nothing whatever about the elements it contains.

I know of a recent classification of welding rods, developed by one of the larger companies, in which the Wickwire-Spencer Company's Grade No. 2 welding rod was classified with rods for hard-wearing surfaces. In this same classification were Stoody Self-Hardening rods and Weldite Type E. If the analysis of Grade No. 2 Wickwire-Spencer Company's rod were unknown, one can easily imagine the havoc which would be wrought by using this rod as a hard-surfacing rod. Fortunately, the Wickwire-Spencer Company in their catalog of welding rods give the analysis, and any one may see that Grade No. 2 for electric arc welding contains:

Carbon	0.13% to 0.18%
Manganese	0.40% to 0.60%
Sulphur	0.04% max.
Phosphorus	0.02% max.
Silicon	0.04% max.

This rod, therefore, conforms to the specification E No. 1B of the American Welding Society. It is not a hard-surfacing rod in any sense of the word and should never be classed as such, because when a weld is made with this rod, the weld metal will be machineable and will be ductile.

If, with the classification mentioned, a welder had purchased a quantity of these rods and had attempted to use them as hard alloy overlays, the result would have been disastrous insofar as his job was concerned and perhaps his reputation.

Misapplication Due to Lack of Knowledge

Another example of this kind came over my desk the other day as a letter from a welder who welded two important parts of an automobile with low-carbon welding rods and the torch. Both of these parts were alike and both broke. He had nickel-steel rods in his shop at the time but did not use them, because he apparently had no knowledge of the steel from which the parts were made, nor did he know anything about the use of nickel-steel as a welding rod. As a matter of fact, neither of these parts should have been welded at all, but it is obvious that a weld made with nickel-steel would at least be stronger than one made with low-carbon welding rods.

There are hundreds of such cases which occur daily. The right welding rod for the job in hand is not used, because the welder knows little about the nature of the metal which he is welding and perhaps even less about the rod which he is using.

Some of you men are engineers; some are superintendents and foremen; some are general managers and others are welders, but whatever your position, if you are interested in doing the best work which welding can produce, you or someone else in your organization should make a study of the metals which you are welding and the welding rods which you are using to determine whether or not you have an economical rod for the purpose and one which will give maximum strength and ductility if required. If your welder is competent to make this study for himself, so much the better; but if he is not, some one in your organization should assume the responsibility and select rods which will produce the desired results.

The matter should not be made one contingent upon price alone. The amount of welding rod used is very small in most cases, and the strength and usefulness of a weld in a highly valuable part may be dependent on the difference of a few cents a pound in the purchase of the rod. Another advantage which a knowledge of the carbon content of the welding rod gives is a more definite understanding of its melting point. Very few welders know the importance of the melting points of welding rods and of the base metal, and few indeed realize that the lower the carbon content of a welding rod the higher will be the melting point. For instance, a low-carbon steel of about 0.06% carbon will begin to melt at approximately 2763 deg. F. Steel base metal having a higher carbon content will have a lower melting point.

Effect of Carbon Content on Melting Point

To be specific, the melting range of steel having a carbon content of 0.05% is, according to the Bureau of Standards, between 2669 and 2768 deg. F. That of steel having a carbon content of 0.30% lies between 2453 and 2714 deg. F. If we should average these ranges for convenience, the average melting point of steel containing 0.05% carbon would be 2718 deg. F., and that of steel containing 0.30% carbon 2583 deg., a difference of 135 deg.

If, therefore, the welding rod has a carbon content of 0.06% and the base metal a carbon content of 0.30%, there will be a difference in their melting points of approximately 130 deg. F. The puddle of molten base metal would, therefore, have to be raised in temperature 130 deg. higher than the melting point of the base metal in order to melt the welding rod in it.

This means that particularly in metal-arc welding there is definite assurance of fusion and penetration of the base metal if the carbon content of the electrode is lower than that of the plate being welded.

Suppose, on the other hand, that a welder picks up a piece of welding rod, the carbon content of which is unknown and that, as a matter of fact, this carbon content is approximately 0.30%. This electrode would have a melting point of 2583 deg. If a weld is made, for instance, upon a piece of mild-steel plate having a carbon content of 0.10%, the melting point of the steel plate would be in the neighborhood of 2693 deg., or approximately 110 deg. higher than the melting point of the electrode.

In this event the welder would proceed in the usual manner without realizing this difference in melting points between the plates and the electrode. The rod, of course, would melt easily, but the plate might not be thoroughly melted as the weld progressed upon it, with the result that there would be little general cohesion between the weld metal and the base metal.

It is true, of course, that more heat in metal-arc welding is developed at the positive pole of the arc than at the negative pole, and the negative pole in steel welding is usually the electrode. This additional heat is to a considerable extent dissipated in the greater mass of the plate or base metal being welded. However this may be, the relationship between the carbon content of the electrode and its melting point should be thoroughly understood and taken into account by the welder.

As a rule, it is good practice to endeavor as far as possible to use electrodes or welding rods having nearly the same melting point, preference being given to a higher melting point for the electrode in most instances.

In gas welding there is more latitude, because the torch can be manipulated to actually fuse or melt the base metal ahead of the welding rod and thus assure the fusion of the two. But even here, a welding rod having a slightly higher melting point than the base metal is good practice.

It is not my intention to infer that there should be any more welding rods on the market than at present. There are too many now and some of them could be eliminated to advantage. I am trying to impress upon the user of welding rods that a better knowledge of their characteristics and a better knowledge of metals will enable the more intelligent use of those rods which are readily available because most of them have their place in welding and satisfactorily accomplish the work expected of them.

Rods for Bronze Welding

Among non-ferrous welding rods, the most widely used rods for gas welding are Tobin Bronze and silicon bronze rods. Tobin Bronze is an alloy consisting of 60% of copper, 1% of tin, and 39% of zinc. This alloy melts at a temperature of 1625 deg. F., and has a tensile strength of approximately 54,000 lbs. per sq. in. The name "Tobin" is a trade-name owned by the American Brass Company, but there are similar alloys manufactured by other companies and known under various other trade-names.

Silicon bronze is a patented alloy, consisting predominantly of copper and zinc, the copper content being about 58% or 60%. There is in addition from 0.10% to 0.25% of silicon and a small percentage of iron and manganese.

These welding rods are used to a very large extent for the bronze welding of cast iron, the iron being heated to a red heat and the molten bronze flowed upon it, adhering with great tenacity to its surface.

Manganese bronze is another alloy used with the torch for bronze welding where a hard surface, having a good wearing quality, is required. The analysis of an average manganese bronze rod is:

Copper	57.50%
Tin	1.00%
Zinc	39.00%
Manganese	1.00%
Iron	1.50%

Manganese bronze is often used for the building up of worn valve seats on automobile cylinder blocks and is specified by some of the railroads for the building up of piston heads and other parts which are subject to abrasion and wear.

None of these rods are used as a metal electrode in electric welding. They may be used in carbon-arc welding; but if used as a metal electrode, the heat of the arc is likely to vaporize the zinc, resulting in porosity of the weld metal and lack of strength. Zinc melts at 787 deg. F., and boils or vaporizes at 1760 deg. As the melting point of the alloy is approximately 1625 deg., it will be readily appreciated that it is quite easy to heat

the molten metal to a point above the boiling point of the zinc content, producing clouds of white smoke which is zinc-oxide vapor. By careful manipulation of the torch and the carbon arc, this vaporization of the zinc can be avoided; but in metal-arc welding, the zinc is likely to be burned away.

For this reason a much more popular electrode is a phosphor-bronze rod which may contain from 95% to 96% of copper; from 3% to 4% of tin, and from 0.25% to 0.40% of phosphorus. There is no zinc in this electrode to vaporize, and it is used for the welding of brass, bronze and light-gage copper and for the welding of cast iron.

Copper Rods

Copper welding rods used for the welding of copper either with the torch or the arc are usually of much interest, although copper has not been welded to as great an extent as it can be and should be if suitable rods are procured. Very few welders realize that there are two distinct grades of copper, one of which is weldable and one is not. The ordinary copper which is familiar to most of us is known as electrolytic copper and many attempts to weld it have failed. The second grade of copper, which has been mentioned, is deoxidized copper, developed by the copper industry especially because of its welding characteristics.

Deoxidized copper is made into welding rods and also into plates, sheets, bars, tubes, etc., and it may be welded without any flux with either the torch or the arc, the resultant weld metal being dense, strong and ductile.

Electrolytic copper is a very pure metal, but all the oxygen in it is not eliminated in the commercial grades and from 0.03% to 0.07% of oxygen remains in the form of cuprous oxide. This small amount of oxygen has no effect on the electrical or physical properties of the products made from electrolytic copper. When, however, an attempt is made to weld it, the cuprous oxide causes so much trouble that many failures have resulted. Cuprous oxide melts at a slightly lower temperature than pure copper. When copper is heated to its melting point with the torch or the arc, the cuprous oxide is already melted, and distortion from shrinkage or mechanical work, such as forging, will cause the metal to crack.

Deoxidized copper, as one would readily imagine, is pure copper from which the cuprous oxide has been removed. This is usually accomplished by the addition of phosphorus or silicon, although other deoxidizers can be used. The deoxidizer combines with the cuprous oxide and the copper is left essentially free of oxygen. Under these conditions it is weldable, and a welder who has attempted to weld electrolytic copper would be very much surprised to find how easily deoxidized copper may be welded.

A very useful welding rod is Everdur, which is an alloy of copper, silicon and manganese made by the American Brass Company. It contains approximately:

Copper	94.8% to 96.0%
Silicon	3.0% to 4.0%
Manganese	1.0% to 1.2%

It has a melting point of 1866 deg. F., and its strength ranges from 52,000 to 100,000 lbs. per sq. in., depending upon its condition.

The patent office has been extremely busy in the last few years in granting patents upon various alloys to be used for welding rods. In fact, it seeems now as if a great rush for patents was in progress, the metallurgists of many larger and smaller companies working at full speed to develop and patent more and more special alloys, or special fabrications, which might be used to advantage as welding rods.

Special Electrodes

There are many special electrodes which have been developed and which give excellent results in many instances. Some of these are a combination of ferrous and non-ferrous metals. For instance, one in particular has a copper core and a sheath of strip steel rolled around the copper core. Another has a copper core with two such sheaths of strip metal. These are flux coated on the outside.

There are many special forms of electrodes. One of these now upon the market is made and patented by the General Electric Company. It consists of a core of a higher-carbon or alloy steel having a lower melting point than the sheath. The sheath is of low-carbon steel, and between the two is a flux containing zinc and sodium titanate. The sheath is in strip form and is formed around the core as the welding rod is drawn through a die.

There are rods with grooves formed in them, into which flux is forced. There are other rods with knurled and checkered surfaces, like a waffle iron, for the lodgment of flux. Triangular sections are put together to form rods, and semi-circular sections having a longitudinal tongue and a groove, with flux between, to form a rod.

Other recent patents include several rods incased in a highly refractory covering and bound together at one end with a ring for electrode-holder contact. It seems as if almost every possible shape, form and combination of steels, alloys and fluxes, coated and uncoated, have been presented to the patent office, and upon many of these patents have been granted. One of the most difficult things is to keep pace with all these developments and to correctly evaluate these rods for their specific uses.

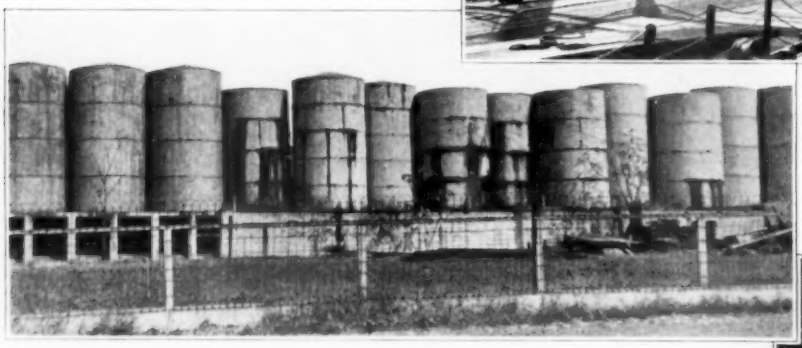
I sincerely hope that this paper will influence the welder to give deeper and more careful attention to the study of this interesting subject than ever before. If he does this and intelligently uses the information which he gains, he will improve the welding process in his organization to a very marked degree.

Alabama Polytechnic Institute to Hold Welding Conference in May

Plans for the second Southwide Welding Conference at the Alabama Polytechnic Institute, Auburn, Ala., next May, are being made by Dan T. Jones, professor of industrial engineering and shops. This conference will bring together many of the outstanding leaders in the welding field. Many technical papers and actual demonstrations will set forth the latest developments in welding, and various manufacturers of welding equipment will exhibit their products. An extensive program of entertainment will be arranged for the visitors

WELDING NEWS IN PICTURES - - -

Welding was used throughout in fabricating these two straight-line cantilever cranes, each of 5 tons capacity, with a 35-ft. maximum range of operation on the dock side. The installation was made by the Orton Crane & Shovel Company for the National Terminals Corporation warehouse at Cleveland, Ohio.



Puzzle: Find three welded tanks. (Photo courtesy *Oxy-Acetylene Tips.*)

The modern plumber carries a complete brazing outfit with him as he plies his trade.

An all-welded propane gas charging station, said to be the first in this country. The left-hand section houses the motor, and the section on the right is the charging room. All pipe lines entering the station are gas welded. This station was built by the Grand Rapids (Mich.) Welding & Supply Company for supplying propane gas to their customers.

Building a Job Welding Business

By W. Irving Brockson

XVI—Hiring, Training and Managing Employees

(Concluding article of series)

"THE director of *men* is greater than the director of *things*."

The job welding shop manager who achieves the greatest degree of success is the one who has the greatest ability to manage men. To be sure, he must be an expert welder himself, but his personal welding ability is secondary to his ability to direct the efforts of others.

The one-man shop, wherein the manager or owner is the entire staff of workers, may not require a very high order of managing ability. However, the great majority of shops, at some time or other, employ one or more helpers. In fact, some of the most successful are known to employ ten or twelve assistants regularly. Just as soon as the shop owner employs one additional man or woman his qualities as a manager come into play.

The job shop owner will probably always spend a great deal of time in actual welding. If he has only one or two helpers he can probably make a full-time man himself. But when his number of employees goes above two, he is confronted with the problem of spending a share of his time in supervision. As the number of employees increases, the time required for supervision will increase.

Whether the shop has one or a dozen helpers, the manager must be very careful not to tie himself so closely down to the torch that he misses big opportunities for business and fails to get the most work done by his employees.

Because of these several conditions outlined above, it may not be amiss to discuss some of those qualifications necessary for success in one who directs the efforts of others and to suggest a few principles for him to follow.

A Plan for Judging Helpers

The principal classes of help which the job-shop owner will be called on to employ are welders, truck drivers, general mechanics and clerical assistants.

Naturally the specific qualifications for each of these groups vary greatly, but there are certain fundamental principles which can be observed in all cases. Three of these are:

1—Decide exactly the duties that will be required in the position in question.

2—Determine just what type of person will best be able to perform those duties.

3—Try to ascertain which of the applicants measures up to the requirements arrived at by the above two points of procedure.

Locating Satisfactory Applicants

In times of business depression the matter of finding suitable applicants for various positions presents no difficulties. On the other hand, many concerns hang out signs reading, "No Help Wanted."

In times of normal business, however, it may be far from easy to locate acceptable welders, stenographers, etc. Naturally this problem varies greatly with the location—whether in a large city or a small town—and with the industrial conditions peculiar to the locality. Some of the sources from which acceptable applicants for any position may be obtained are:

First, personal acquaintances who may be looking for work.

Second, very frequently an inquiry made among nearby foundries, machine shops, and other manufacturing plants will reveal the names of prospective employees.

Third, labor unions usually maintain a list of men who need work.

Fourth, schools of various sorts often will furnish employers not only with lists of students who are about to graduate, but also a list of previous graduates who may be unemployed.

Fifth, employment agencies usually have on file the names of several individuals capable of filling a variety of jobs. There is no charge, as a general rule, to the employer for this service. In working with an agency it is highly desirable to specify in detail the qualifications desired in an applicant, explaining those which are most essential, those less essential, and faults or shortcomings which will be a positive block to employment.

Sixth, advertisements in the classified sections of newspapers and trade papers.

After several applicants have been located by one means or another, then the job shop manager should bring into play his job analysis and his personality analysis suggested earlier.

Sizing Up a Welder

It is unnecessary to list all of the qualifications required for any particular job, because they vary so much from one shop to another. However, the following suggestions may be helpful in sizing up prospective employees.

In the case of a welder, it may be desirable to consider his proficiency as well as experience according to class of work, such as boiler, structural steel and other classes of welding; or according to the particular type of welding process, such as electric, gas, and automatic; or according to the kind of metal to be welded, such as monel, stainless steel, or other of the newer metals. His ability as a general mechanic should also be checked up. In addition to these qualifications, which might be called professional, he should be investigated from the standpoint of honesty, reliability, dependability and loyalty. Is he ambitious or lazy? Is he sober? Has he any peculiarities which would make him an unworthy representative of your shop?

Judging the Prospective Stenographer

In the case of feminine help for clerical and stenographic duties, a different set of qualifications is involved. It may be advisable to obtain information relative to the applicant's experience and proficiency in operating a type-

writer or an adding machine, in taking dictation, in keeping books and other records, in composing business letters from only the barest outline of facts from the manager, contacting customers by telephone or in the office, etc. Naturally, the qualities having to do with personality and character as they relate to the position at hand should also be investigated.

Discussing the Job Thoroughly

It is always desirable to talk things over very carefully with the applicant. Not only should all phases of his past experience be discussed, but also the requirements of the job which he is about to undertake. Usually it is good practice to talk things over on two or three different occasions, prior to arriving at a final agreement. Particularly it is recommended that the cards be placed on the table "face up" with regard to what is expected on the job. It is better to discuss things thoroughly in advance than to have a misunderstanding later. The old saying, "Act in haste and repent at leisure" has a peculiar significance when applied to hiring help.

If the applicant is a stranger it is a good idea to ask for references. Many successful concerns follow a practice of getting written reports from all the references before any agreement is made with the prospective employee.

After you have arrived at a final agreement with your applicant on salary, exact duty, hours of labor, vacations and other details, the next problem at hand is giving the worker a preliminary training.

Supervise the Worker Closely at First

Unless the new member of your organization is an "old timer" on the work which he has been hired to do, it is desirable to explain things very carefully at the outset and closely watch the first few operations. Painstaking explanations and frequent check-ups in the first few days of employment, particularly with the men of less experience, is a highly desirable quality and is a means of forestalling unsatisfactory work later on.

If the proper understanding has been reached in advance, and if the explanations and the corrections are given in a friendly, straightforward, man-to-man fashion, the applicant will understand the reason for initial supervision and will not resent it. If the worker shows progress and improvement, the closeness of the supervision can gradually be relaxed.

Supplying Inspiration and Incentive

Perhaps more important than the instruction and supervision is the matter of inspiring men. To do his best every worker must have a definite objective. The most successful manager is the one who supplies that incentive to the people working for him.

There is undoubtedly a trend toward shorter hours of labor. On the other hand, it should be borne in mind that the worker who has the proper incentive and hope of reward of one kind or another, will gladly work for you sixteen hours a day, whereas if he has no such objective he probably will grudgingly work six hours a day. Therefore, the job welding shop manager must supply these incentives by every means at his command, such as holding up to the employees the assurance of regular pay and regular employment, the possibilities of profit sharing opportunities to come, a pride of working for a high-grade concern, possible vacations with pay, and other things, so as to keep the employee interested in his job, and willing to give his best. A simple but all-important prerequisite to inspiring workers is that the "boss" be honest and a "square shooter" in all his dealings.

Prodding Some and Complimenting Others

Men are not all inspired alike; one will require one kind of treatment and another a different kind. Some have to be prodded along, others have to "bawled out" every so often, and still others need to be "kidded." It is the job of the successful manager to find just the kind of treatment which is most successful in each individual case and to apply it.

One of the best ways of satisfying the first-class employee is by the judicious handling of raises. Many employers make it a practice to hire workers with a definite understanding of raises which are to take place within a specified time if the employee makes good. If such a policy is followed, the promised raise should be proffered at the time specified, or the employee definitely told that he has not earned it.

It is usually better and more inspiring to give frequent raises, though they may be small, than to give a large raise only once every year or two. Every one likes to have frequent evidences of his advancement. Small raises at relatively frequent intervals are evidence of success and a great stimulant to the morale of the employee.

A homely, yet effective, way to gain men's confidence and bring out the best in them is simply to be "human" in all dealings with them. Show interest in their home life, laugh with them about their kids' antics, show a genuine concern when a wife is ill at home, "laugh when they laugh, weep when they weep." Avoid being "high hat" or "up stage."

The Value of Fair and Impartial Discipline

Regardless of how much the employer may do to inspire workers, or how well he treats them, there are some men who must be disciplined periodically. There comes a time when it is necessary for the boss to "put his foot down." A successful employer is the one who knows how to pass out discipline and to do it fairly and justly and without favorites.

If there are several men on a job and one is able to get by with sloppy work or with loafing, the morale of the entire group is adversely affected. Nothing is more stimulating to a gang of men than to know that the boss is on the job, detecting imperfections and pointing them out no matter "whose toes may be stepped on."

Keeping a Jump Ahead

When all is said and done, the most successful job shop operator is the one who inspires and leads his men as opposed to driving them. Even though the manager may get to the point where he does very little welding himself, it is necessary that he "keep a jump ahead" of his men in the knowledge of handling particular jobs and in the ability to take the torch and demonstrate the best way, when necessary.

To be a success at operating a job welding business above the "one horse" class, the manager—who in most cases is also the owner—must continually improve himself in three directions: first, in welding skill and welding practice; second, in the business side of his enterprise, which deals with advertising, purchasing, credits and collections, salesmanship, etc.; and, third, in selecting, training and managing employees. To achieve big success, the last is most important.

Burdett Salesmen Atop Lookout Mountain, Laying Strategic Plans for 1933.
Left to Right: S. R. Jones, R. G. Wilson, W. P. Hendricks, C. T. Price, M. E. White.

Burdette Southeastern Division Holds Sales Discussions on Mountain Top

The sales meeting held October 21st to 23rd for the representatives from the Southeastern Division of the Burdett Oxygen Company was a most unusual one. It has been the established custom for years for the district men to meet twice a year for a conference in Chattanooga, Tenn. The unusual feature of the recent meeting was the precedent established by C. T. Price, general sales manager from Chicago, who made preparations for part of the conference to be held in the Read House in Chattanooga, with the remainder of the discussions to take place on the crest of Lookout Mountain 2450 ft. above sea level. The view attained from Lookout Mountain practically encompassed all the states in which the Southeastern division of the company operates. Seven states can be seen from this vantage point, these being North and South Carolina, Georgia, Tennessee, Alabama, Kentucky, and Mississippi. This mountain and surrounding territory was the scene of several important battles of the Civil War, and the sales battles of 1933 fought on its summit were considered of no small importance by the Burdette organization, who were high in their praise of their first outdoor convention in the clouds.

Death of J. R. Foran

John R. Foran, a well-known figure in the welding and compressed-gas fields, died October 15th at Kansas City, Mo., as a result of a heart condition which first indicated itself three years ago. During the nine months prior to his death, Mr. Foran was compelled to take a rest from his duties as president of the Puritan Compressed Gas Corporation, at 2012 Grand Ave., Kansas City. He was a past director of the Gas Products Association, and was active in the Kansas City Chamber of Commerce.

Mr. Foran was born in Quebec, later moving to New York, and in 1899 he settled in Kansas City, where he became a manufacturer of chemicals. In 1915 he and Parker B. Francis became interested in the Puritan Compressed Gas Corporation and they built this company up to be one of the strongest independent companies in its line of business in this country.

E. J. Hayden Elected President of International Acetylene Association

At its annual business meeting held in Philadelphia, on November 18th, the International Acetylene Association elected as president E. J. Hayden, central division manager of The Linde Air Products Company, Chicago, who was formerly vice-president. H. B. Pearson, of Compressed Industrial Gases, Chicago, was elected vice-president to succeed Mr. Hayden. The following directors were also elected: W. C. Keeley, Jr., National Carbide Corporation, New York; W. H. Ludington, Air Reduction Sales Company, New York; H. S. Smith, The Prest-O-Lite Company, Inc., New York; C. A. McCune, *Industry and Welding*, New York; W. D. Flannery, Harris Calorific Sales Company, New York; L. F. Loutrel, Shawinigan Products Corporation, New York; A. J. Fausek, Modern Engineering Company, St. Louis; and Philip Kearney, K-G Welding & Cutting Company, New York.

E. J. HAYDEN
President, International Acetylene Association

Mr. Hayden, the new president, has been connected with the sales and development phases of the oxyacetylene welding and cutting industry for more than 18 years—a span representing practically the entire period of the growth and development of the process.

Blukote Electrode Developed for Cast-Iron Welding

An electrode which, used with direct current for cast-iron welding, is said to produce a weld that is low in carbon and is easily machined, has been announced by the Central Steel & Wire Company, 4545 S. Western Blvd., Chicago, Ill. This new electrode, known as Blukote, is of the sheath type, reducing the heat to a minimum. Due to the lack of penetration, the carbon of the casting, which is relatively high, is not diffused into the weld. As a result the weld is very easy to machine.

This low penetrating power of the arc is also said to make Blukote adaptable for thin-sheet welding, eliminating burning and distortion of the sheet. This rod was developed in the laboratories of the Central Steel & Wire Company.

Portable Outfit Makes a Hot Flame for Slip-Joint Brazing and Soldering

A small, portable acetylene unit with regulator, torch, tips, and attachments, for brazing and soldering, has been announced by Swift Equipment Manufacturers, West Alexandria, Ohio. This unit, known as the Swift-Solder-Braze Equipment, utilizes an air-acetylene flame of sufficient heat intensity to perform all kinds of soldering, or braze copper pipe to slip fittings, using phosphor-copper alloy rods, such as "Sli-Fos" or "Phos-Copper," or braze thin-wall steel slip or lap joints with bronze brazing rods melting at a little over 1600 deg. F., or braze lap joints on both copper and steel alloys in thin metal.

This unit is also suitable for babbitting, lead welding, bending, expanding, fender straightening, hardening, loosening nuts and bolts, melting low-temperature metals, rivet heating, thawing pipes, tempering, and for many other purposes. It can be provided with an attachment for flood-lighting work in progress. The unit is very light and takes up but little space. The gas is made only while the torch is in operation; and when the torch is turned off, the machine automatically stops feeding carbide.

With the addition of a simple flashback and safety blowoff, this machine will sup-

ply gas for doing a great variety of small welding and cutting jobs, in addition to its usual function of soldering and brazing.

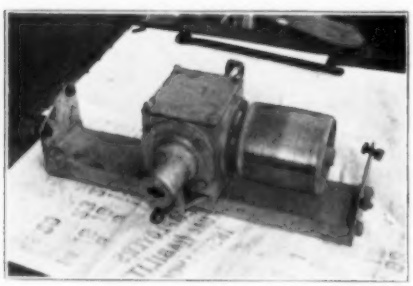
The complete unit consists of water tank,

Complete Unit for Brazing and Soldering

carbide hopper, pressure gage and tee, torch, tips, and attachments, 15 ft. of hose, hopper-filling funnel, and two charges of carbide.

New Device Allows Welder to Be Driven From Ford Car

The Ford "A" Model "Safe-Weld" Power Take-Off is the name of a new device manufactured and sold by the Welding Engineering Company, Milwaukee, Wis., for attachment to the front of Ford cars to enable the engine to drive an arc welding machine. This unit can be installed on a Ford car in three hours, it is claimed, and can be left on permanently, as



Power Take-Off for Attachment to Ford Car to Drive Welder

it provides its own fan in the place of the regular Ford radiator cooling fan, and the regular Ford crank ratchet is inserted in the front end of the power take-off unit.

The unit is detachable from the car in five minutes and can be cut in or out of gear in ten seconds. It is equipped with a belt pulley for driving the welder, and a special governor maintains a constant engine speed. The welder can be mounted on a trailer and towed behind the car when going to and from the work. Four Timken bearings are used. The take-off pulley is 6x6 in., and the weight of the unit is only 60 lb.

This unit is essentially a substitute crankshaft pulley installed to replace the regular Ford pulley. It is fastened by three pins, and for permanence it is collared. A square hole in the end of the new crankshaft fan pulley accommodates the square-headed drive shaft from the power take-off unit. The flexible crankshaft joint takes up all vibrations.

New Coated Electrode for Manganese Welding

A new coated electrode for manganese welding, designated as Type W-85, has been announced by the General Electric Company. This new wire finds its principal application in the building up of worn manganese-steel castings to original dimensions and in the repair of such fractured parts. It also can be readily applied to obtain a manganese-steel surface on parts of ordinary steel and iron, thereby giving the parts a tough, work-hardening, wearing surface at a low cost. Other applications will be found in worn equipment. Considerable saving is possible through reclaiming dipper teeth, crusher mandrels, and all pulverizer parts, as well as worn parts of numerous items of equipment used in the oil fields. In addition, this new electrode should be of great interest to the traction industry for building up worn switches, frogs, and cross-overs.

The following features are claimed for this new electrode:

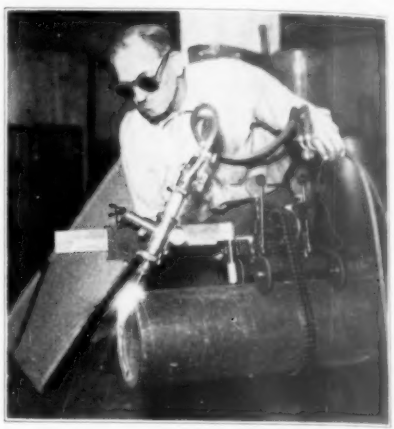
(1) Reliable welds can be made by relatively unskilled operators. (2) When the rod is melted in the atmosphere and applied to ferrous metal articles, it exhibits the essential characteristics of standard heat-treated manganese steel, that is, toughness, ductility, and surface hardening under cold working. The nickel content overcomes any tendency of the metallic manganese content of the rod to oxidize and prevents brittleness under slow cooling. (3) No quenching of the weld-metal is necessary. The nickel successfully "carries" the relatively high carbon without affecting the ease of welding, and the high carbon, in turn, gives excellent wearing qualities to the weld. (4) The electrode is furnished with a coating which has a high arc-sustaining property, making the wire readily adaptable to both a.-c. and d.-c. welding.

Airco Announces New Pipe Cutting and Beveling Machine

The carriage of the new Airco Style No. 1 pipe beveling machine is held against the pipe by a roller chain which engages a crank-driven chain sprocket. After adjusting and lighting the torch, the operator turns the hand crank, thereby turning the pipe or, if the pipe is not free to turn, the machine rotates around the pipe. A smooth, uniform bevel, square with the pipe axis, is produced.

The cutting torch is adjustable on the bracket to any required bevel angle from vertical, for cutting off square, to 45 deg. more or less for any welding bevel required. The torch may also be adjusted laterally to produce a lead cutting angle, which is found necessary on bevels for clean cuts free of slag. This lead angle varies slightly with the pipe diameter and wall thickness.

This machine can be fitted with two cutting torches set opposite each other for cutting screw couplings out of old pipe at one operation, and at the same time beveling the ends of the pipe for welding. For making a branch connection, the torch

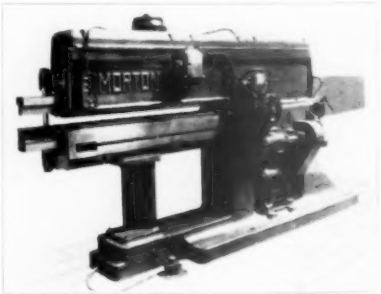


Crank-Operated Pipe-Cutting Machine

is racked back and forth along the horizontal bar while the cut progresses, the torch following the layout line made on the pipe with a templet. Other pipe fabrication, such as multiple-piece ells, wyes, reducers, and bull-nose closures, also pipe clotting for gravel screens and coupon cutting for weld tests, are uses to which the machine can be put.

Draw-Cut Flash Trimming Machine Controlled Through Push Buttons

Electric control through push buttons designed for hand or foot operation is one of the features of the latest Morton high-duty draw-cut flash trimming machine, shown in the illustration. This device is



Morton Flash-Trimming Machine

used to trim the flash or upset from butt-welded seams in strips, sheets, or plates, and can be furnished in any length of cutting stroke desired, the machine shown having a 48-in. cutting stroke.

This machine has removable liners to the ram bearings, which assure accuracy in work and long life to the machine. The work is set against a stop block, making it unnecessary to use heavy pressure in binding. Since pneumatic clamping is dispensed with, compressed air is not necessary for its operation. The operating

TOBIN BRONZE

. . . is but one of seven Anaconda Copper-Alloy Rods for gas and electric welding

IMPORTANT savings to industry . . . both in production and in repairing plant equipment . . . have resulted from the development of Bronze Welding. Copper alloy welding rods, because of their strength and low melting points, are extensively used for welding iron, steel, copper and copper alloys by both the oxy-acetylene and carbon or metal arc methods.

EVERDUR (for gas or electric welding) is a patented alloy of copper, silicon and manganese and has excellent welding characteristics. Makes high-strength welds on copper, brass, bronze and copper-nickel alloys. Also used on thin sheet metal. Melts at 1866°F.

* * *

ANACONDA MANGANESE BRONZE (for gas welding) produces a tough, strong bond, unusually resistant to wear. Especially adapted for building up surfaces subject to abrasion. Melts at 1598°F.

* * *

ANACONDA PHOSPHOR BRONZE (for gas and electric welding) is extensively used for electrically welding copper, brass, bronze, wrought, malleable and cast iron, low and high carbon steels. Melts at 1922°F.

* * *

ANACONDA BRAZING METAL (for gas welding) is a high-zinc brass for welding where strength is not essential. Melts at 1634°F.

* * *

ANACONDA ELECTROLYTIC COPPER (for gas welding) is recommended for welding copper where high electrical conductivity is essential. Welds are quite ductile. Melts at 1981°F.

* * *

ANACONDA SILICON COPPER (for gas or electric welding) is used to fabricate metal furniture and for other sheet metal work. Requires no flux. Has a good electrical conductivity and makes a strong, sound weld. Melts at 1981°F.

There are seven different Anaconda Welding Rods, each with individual characteristics . . . each particularly adapted to certain types of work. Tobin Bronze—the most widely used because of its acceptance as the ideal rod for the general oxy-acetylene welding of cast-iron and malleable iron—melts at 1625°F.; preheating is usually unnecessary.

The uniform composition and high quality of Anaconda Welding Rods are due to the experience and technical knowledge of The American Brass Company. Tobin Bronze and six other rods described in the column at the left are available through leading distributors of welding supplies...usually shipped in bulk, but also obtainable in clearly labeled ten-pound packages. For complete information ask for Publication B-13.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONNECTICUT
OFFICES AND AGENCIES IN ALL PRINCIPAL CITIES

ANACONDA WELDING RODS

floor space required is approximately 5x14 ft., and the shipping weight of the machine is approximately 8000 lbs. The machine is manufactured and sold by the Morton Manufacturing Company, Muskegon Heights, Mich.

Pamphlet on Stainless-Clad Steel

The Ingersoll Steel & Disc Company (a division of Borg-Warner Corporation), 310 S. Michigan Ave., Chicago, has issued a folder describing the composition, method of manufacture and fabrication of Ingersoll stainless-clad steel as well as illustrating and listing many applications for this new low-cost corrosion-resisting material.

Engineering Properties of Monel Metal

Bulletin T-5, with the above title, has been issued by the Development and Research Department, The International Nickel Company, Inc., 67 Wall St., New York, N. Y. Information is given on mechanical properties, physical constants, resistance to corrosion by acids and other solutions, mill products, working properties, and chemical composition of monel metal. Welding and soldering, though briefly covered in this bulletin, is treated more fully in Technical Bulletin T-2.

New Bulletin on Grinnell Welding Tees

Dimensions and prices on welding tees are given in Bulletin A-9, recently issued by the Grinnell Company, 277 W. Exchange St., Providence, R. I. A sectional view of one of these tees is shown to illustrate the uniform thickness of the walls and the rounded surface at the outlet. The various outlet diameters available with the different sizes of pipe run are given.

Grinding Wheels Permanently Mounted on Shanks

One hundred different shapes and sizes of grinding wheels on shanks are listed in a catalog recently issued by the Chicago Wheel & Manufacturing Company, 1101 W. Monroe St., Chicago, Ill. Speeds, dimensions, and prices are given, together with a table showing the number of wheels applicable to various metals and alloys. The booklet discusses the advantages of permanent mounting on shanks.

New Westinghouse Bulletin on Arc Welding

A 20-page illustrated booklet describing the features, characteristics, and applications of the Westinghouse FlexArc Welders is available from the district offices and from the advertising department of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The theory of this welder is gone into at some length and test results are discussed.

Welding Structural Beams to Obtain Rigid End Connections

Elementary principles underlying the purpose of rigid end connections, and how such connections may be obtained by welding beams to columns, are discussed in Plate 38 of "Studies in Structural Arc Welding," entitled "Arc-Welded Tier Buildings," recently issued by The Lincoln Electric Company, Cleveland, Ohio. Rigid connections are discussed from the standpoint of rigidity and of obtaining continuous-beam action. Simple diagrams are used to illustrate the theory.

Just a Few of the Bright Spots

Because of the general adoption of arc welding for shop fabrication, less than 500 lb. of rivets will be used this year by the Leitelt Iron Works, of Grand Rapids, Mich., it has been estimated by F. H. Meyer, general manager. The plant is being kept on a good production schedule.

A 47-mile section of the welded 58-in.-diameter water pipe line, known as the "Hetch-Hetchy Line", has just been completed across a portion of the San Joaquin Valley, of California. This line forms a part of the new water supply system for the city of San Francisco, and is being constructed by the Western Pipe & Steel Company, of San Francisco and Los Angeles. The fabrication of this pipe as well as the field welding of the line is being done by electric welding.

A great amount of welded construction will soon be under way at Turtle Bay, Lower California, in the construction of a large fish cannery, which will replace one recently destroyed by fire. The cannery will have a large refrigeration plant which, in itself, will require a considerable amount of pipe and other welded construction. The plant is being built by Ocean Industries, Inc., with offices in San Diego, Calif.

Sales of arc welders recently reported by A. H. Friese, of the Welding Engineering Company, 2872 North 41st St., Milwaukee, Wis., included sales to Olaf Haarvei, of Mondovi, Wis.; Milwaukee Stamping Company, of Milwaukee; Kupfer Foundry & Machine Company, of Madison, Wis., and L. G. Carter, of Monroe, Wis.

Indiana concerns that have recently purchased arc welding machines are the Chrysler Corporation, at Newcastle, and Switzer Cummings, of Indianapolis. The latter has obtained a 300-ampere Lincoln shielded-arc welder, and the Chrysler equipment includes a 300-ampere G-E arc welder and a G-E automatic welding head.

A. H. ("Slim") Carstens, proprietor of the Ottawa Welding Works, Ottawa, Ill., has moved from his old place on West Main St. to larger quarters on Marquette St. "Slim" specializes in hard surfacing, and enjoys an excellent business among the farmers in the corn belt. He also did a fine business with the contractors on the Lakes-to-Gulf deep waterway this year in keeping their equipment in working order.

Among Ohio industries recently purchasing arc welding machines are the Logan Gear Company, of Toledo, the Cleveland Tractor Company, of Cleveland, The Proctor & Gamble Company, of Cincinnati, and the Frigidaire Corporation, of Dayton. The Logan Gear and Cleveland Tractor companies bought G-E machines, and the Proctor & Gamble and Frigidaire machines are of Lincoln make, the latter being the "Electronic Tornado" type.

The Bond Welding Shop, Buckley and Division Sts., Grand Rapids, Mich., of which A. H. Bond is manager, are preparing for increased business activity by remodeling and increasing the size of their plant. The new building will occupy the entire corner and will have entrances onto both streets.

A large welding contract has just been completed by the Consolidated Steel Corporation, of Los Angeles, Calif., in the fabrication of a large pressure distillate stabilizing unit for the Wilmington refinery of the Union Oil Company of California. Automatic electric welding was employed principally in the construction of this unit.

J. B. Beenen, proprietor of the Michigan Welding Company, 341 Grandville Ave. S. W., Grand Rapids, Mich., has received a contract to build some plating tanks for the J. C. Miller Company, of Grand Rapids. Each tank will be 58 in. wide, 108 in. long, and 36 in. deep and will be made of ¼-in. tank steel and of arc-welded construction, and upon completion will be lead lined. This shop, while no larger than the average job welding shop, has lead lined over 1200 tanks in the last four years, and up to the present short hours are unknown to them.

Construction work which will call for a great deal of welding has just been announced by the J. W. Ross Dog Food Company, of Long Beach, Calif. This company has acquired an old beet-sugar factory at Los Alamitos, and will rebuild the plant for the production of their dog and cat food products. This work will require a great deal of acetylene cutting as well as welding in the removal of the old equipment, installation of the new, and other general changes in the plant. Several welders are already at work on this job, the completion of which will require several weeks.

News in Brief

Robert Notvest, well-known welding engineer of Indianapolis, Ind., has severed his other connections and is now devoting his entire time to the J. D. Adams Company of that city as consulting welding engineer.

"Field Welds in Pressure Pipe Lines for Steam Service" was the subject of a talk by Hans N. Boetcher, assistant to the superintendent of steam stations, Consolidated Gas, Electric Light & Power Co., before the Baltimore, Md., Section, A.S.M.E., on December 14th.

The Leitelt Iron Works, Grand Rapids, Mich., are building a complete orchestra lift and elevator for the Civic Auditorium in Grand Rapids. The entire lift is 8 ft. wide, 50 ft. long, and has a 20-ft. travel. The platform, which is 4½ ft. above the traveling units, has all-welded structural members. The base unit carrying screws, which do the lifting, as well as all motor-base and gear-base units are all welded.

Ora Abel, formerly with the Slinkard Welding Service, Bedford, Ind., recently purchased a 200-ampere Hobart portable arc welder and is opening a general job welding shop at Batesville, Ind.

Shartle Bros. Machine Co., manufacturers of paper mill machinery, Middletown, Ohio, recently purchased a 600-ampere Lincoln arc welder. This concern has just completed two all-steel beaters. They are making an extensive study of arc welded design and fabrication as compared to iron castings.

A. A. Potter, dean of the schools of engineering, Purdue University, was recently elected president of the American Society of Mechanical Engineers.

The Cincinnati & Ohio Railroad recently purchased a 400-ampere Lincoln shielded-arc welder for their shops at Huntington, W. Va.

The Indiana Oxygen Company, of Indianapolis, Ind., announces the appointment of Wm. ("Bill") Zimmerman as general sales manager.

Jake Underwood, operating a welding equipment rental and sales service in Bell, California, recently moved his business location from 4006 E. Slauson Avenue to 7504 Atlantic Blvd., where larger and more convenient quarters are available. Mr. Underwood has nine 500-amp. portable electric welding units for rental service, and three electric cutting machines and a number of acetylene outfits. In connection with the rental service, a special feature of Mr. Underwood's plant is an arrangement with two other men who will feature shop and field welding of all kinds, each being specialists in their particular line. John Green, formerly with the Vernon Welding Works, in Los Angeles, will handle all acetylene welding jobs, both shop and field, and will specialize in the welding of stainless steel and other non-corrosive alloys. Walter Hartshorn, specialist in structural steel welding and boiler work, will handle electric welding, specializing in structural steel welding contracts. The new concern will be operated under the name of the Electric Cutting and Welding Company. Mr. Underwood has been in the welding equipment business in and near the Los Angeles district for the past eight years.

The designing engineers, electrical engineers, maintenance men, and department heads, to the number of 35, of the American Rolling Mills, Middletown, Ohio, attended a three-day course in the arc-welding process and the theory of design for welded steel construction, held under the direction of E. W. P. Smith, consulting engineer, The Lincoln Electric Company, early in November. Mr. Smith's lectures consisted of discussions of arc-welding generators, various electrodes, calculation of stresses in welded joints, substitution of welded steel for castings, and the

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WELDING RODS

theory of redesign for welded construction. The lectures were supplemented by demonstrations in the shop.

Earl M. Evleth, of The Bastian-Blessing Company, gave an address on "The Welding Industry as It Applies to Engineers and Engineering Problems," before the Grand Rapids, Mich., unit of the National Association of Power Engineers, on November 28th.

Seventy-five students, faculty and guests of the American Laundry Institute, of Joliet, Ill., showed great interest in two "Rego" pipe welding films shown before them on November 10th by H. O. T. Ridlon, of the Barrett Hardware Company, of Joliet, who also gave a talk on the economies of pipe welding in laundries.

A. G. Odell, of the Denver Opportunity Public School, Denver, Colo., gave a talk on "What Related Subjects Should Be Taught to Welders, Cutters and Others Interested?" before the Trades Industrial Section of the Eastern Division of the Colorado Education Association, at their 58th annual meeting held at Denver, November 10th to 12th.

The Atlantic Oxygen Company have moved their executive offices to 767 Lexington Ave., New York, N. Y.

Among the personnel of the organization of the Hercules Motors Corporation, of Canton, Ohio, who will be present at the Highway and Building Congress to be held in Detroit January 16th to 20th will be the following: D. W. Latta, Clyde R. Schuler, W. W. Cromley, C. P. Weeks, A. B. Wehling, and John Keplinger.

The Alexander Milburn Company, of Baltimore, Md, has opened an office at 549 West Washington St., Chicago, Ill.

Properties of the Lake Erie Steel & Blanking Company, Cleveland, Ohio, jobbers of sheets and specialists in supplying sheared blanks for press shop requirements, have been acquired by the American Rolling Mill Company, Middletown, Ohio. M. S. Phillips, assistant to the general manager of sales for the American Rolling Mill Company, has been made president and general manager of the Lake Erie Steel Company.

The Austin Company, of Cleveland, Ohio, have organized a concern to weld bases for large Diesel engines. They are associated with the Winton Engine Company in this development.

The Grand Rapids Welding Supply Company, of Grand Rapids, Mich., are promoting a series of talks and demonstrations on liquid oxygen before various groups and organizations in the western part of the state.

The Chicago Bridge & Iron Company's representatives to the Purdue University welding conference, December 8th and 9th, had the distinction of being the only group to fly to the meeting. The party consisted of George Horton, president; Charles Pillsbury, manager of operations, and H. C. Boardman. The trip was made in Mr. Horton's plane.

The Central Indiana Coal Company, of Linton, Ind., recently purchased a Lincoln 600-ampere shielded-arc welder.

The Michigan State Agricultural College, East Lansing, Mich., is contemplating the holding of a welding conference some time this winter or early spring. This will be the first conference of this nature at this institution and will be held under the auspices of the engineering department.

E. M. Cushing, president of the Industrial Engineers' Society of Indianapolis, Ind., announces that this group will make an intensive study of industrial research. Robert Notvest, consulting welding engineer, stated in a recent address before the society that "the engineer of today must recognize that there is a new system of economics applying and the methods of ten and twenty years ago are obsolete."

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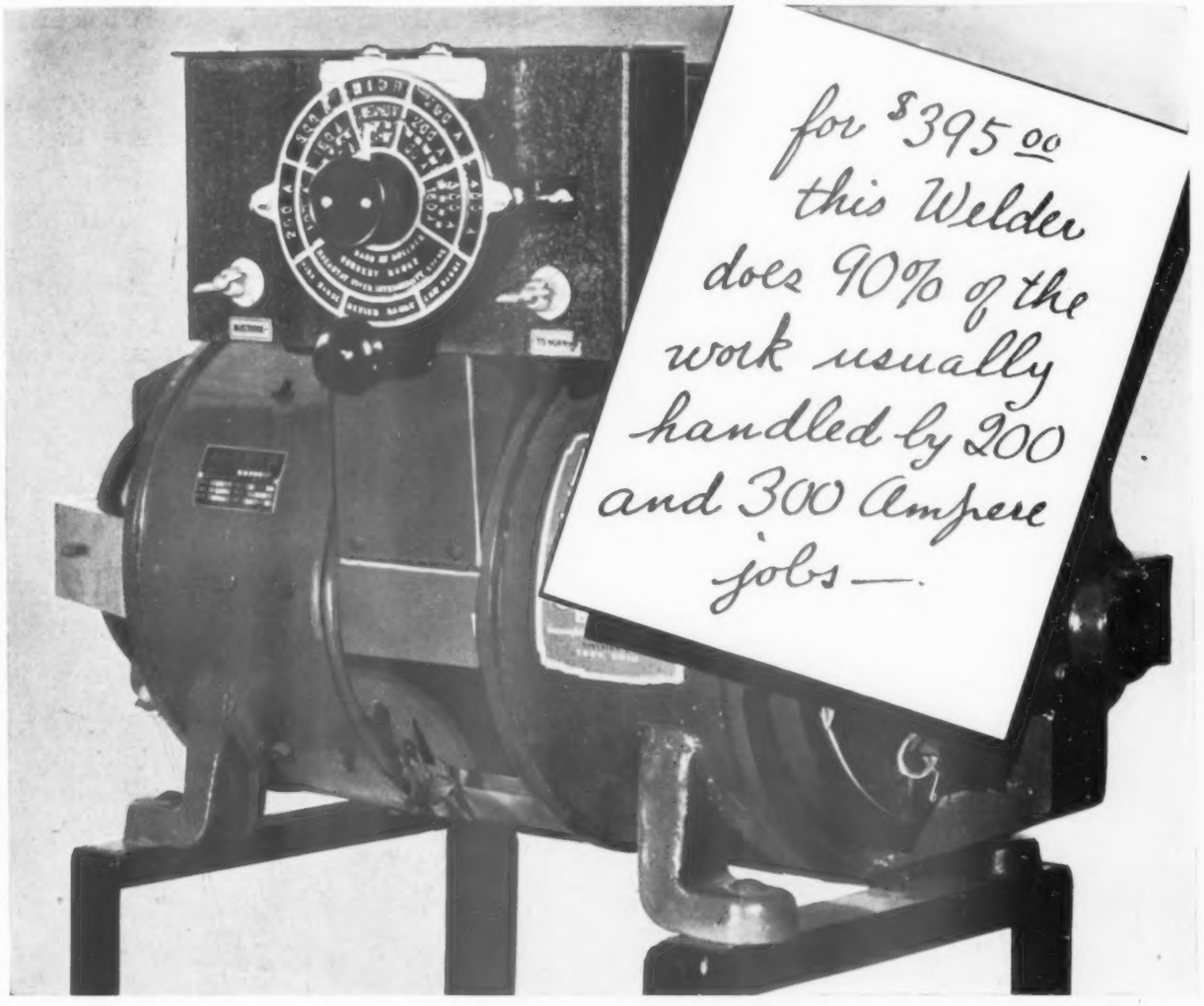

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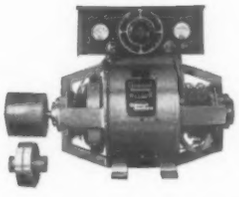

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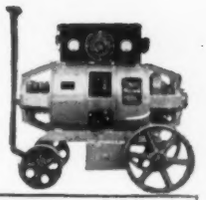

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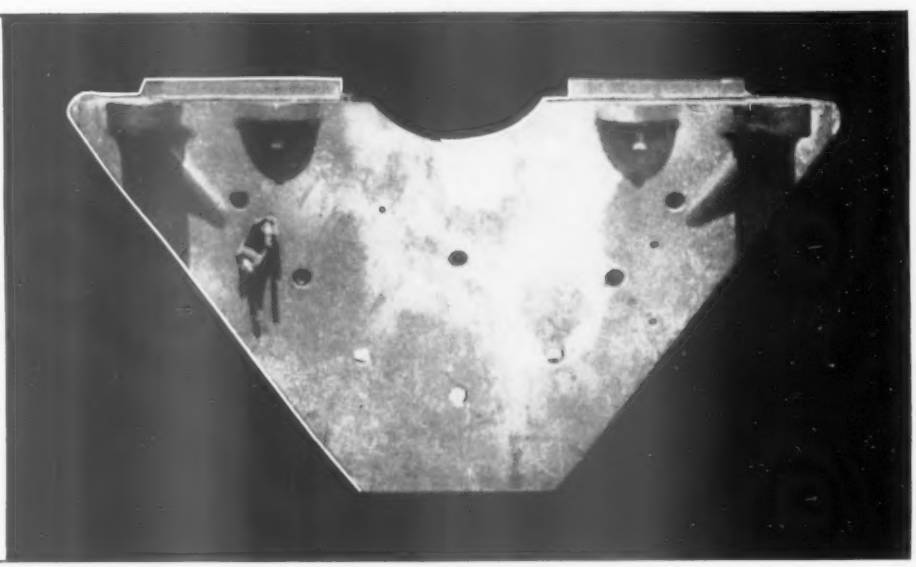

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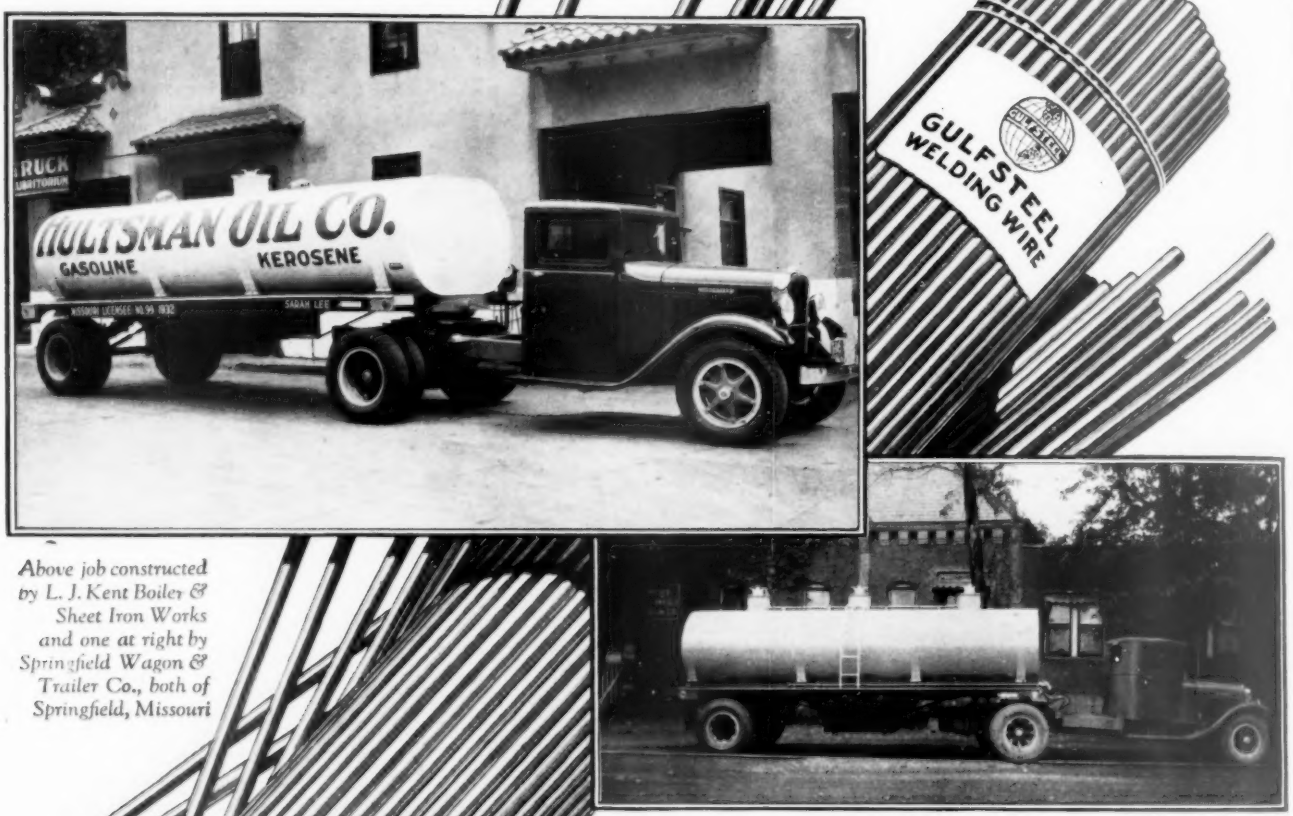

Above job constructed by L. J. Kent Boiler & Sheet Iron Works and one at right by Springfield Wagon & Trailer Co., both of Springfield, Missouri

AN otherwise neat fabrication job can be marred by non-uniform welding, *due more often to the lack of uniformity of the welding material* than to the lack of skill of the welder . . . . . That's why these two fabricators specified GULFSTEEL WELDING RODS as well as Gulfsteel sheets, bars and channels. Gulfsteel control begins at the mine and ends only with the coating of the rod. Thus you are assured that the last rod in the bundle will leave a deposit EXACTLY like the first. Results are CERTAIN when Gulfsteel "Complete Procedure Control" Rods are used.

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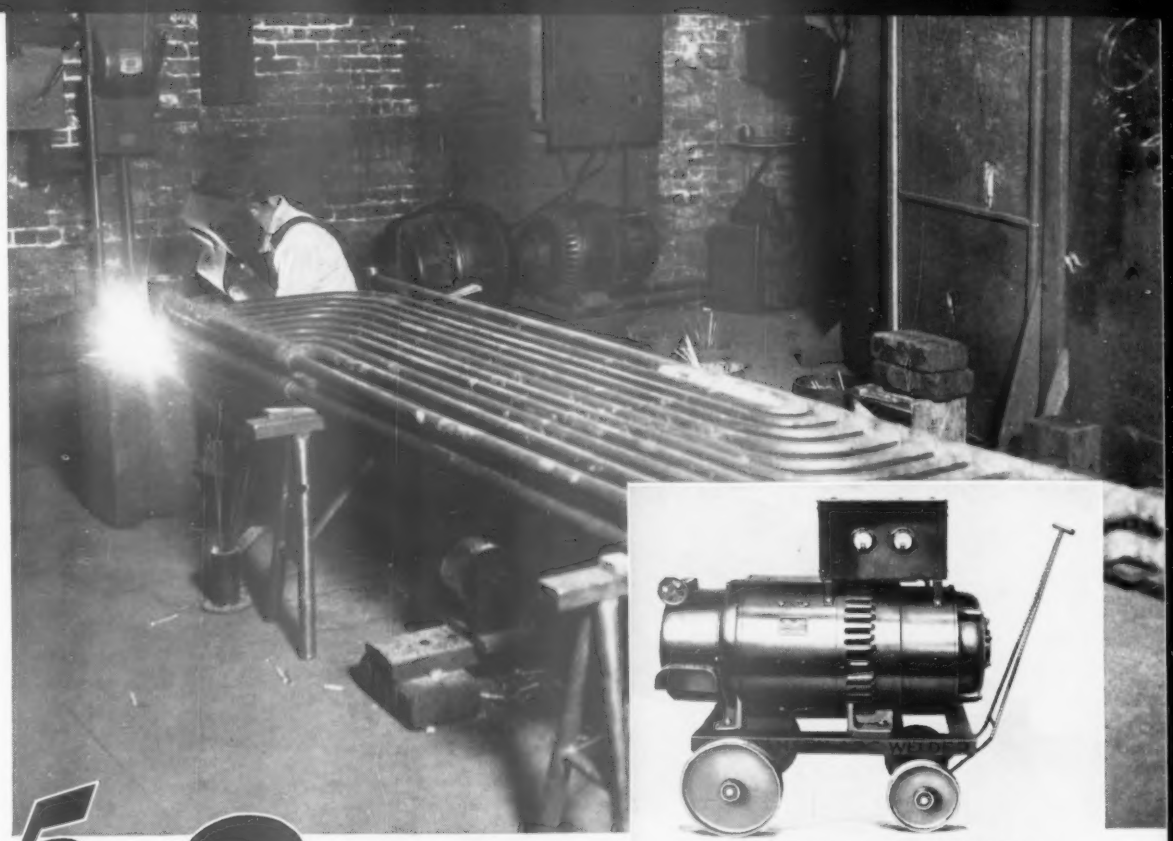

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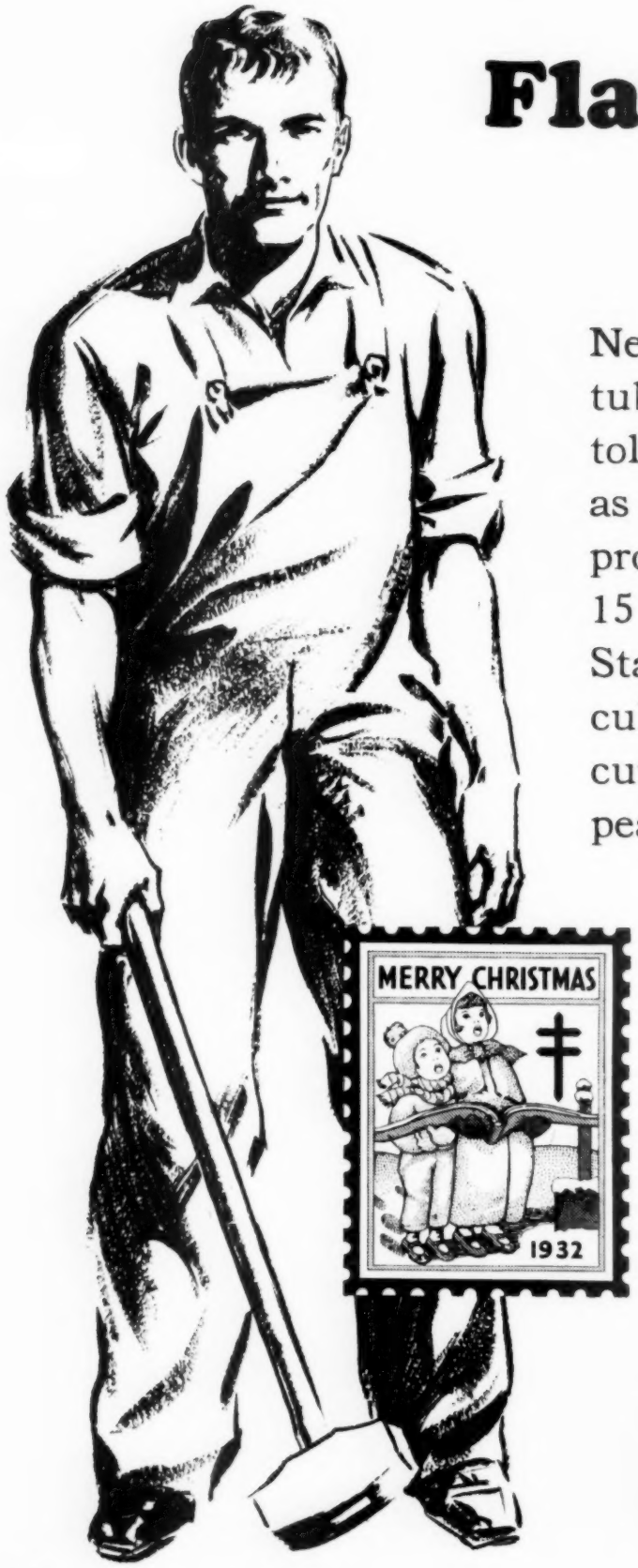

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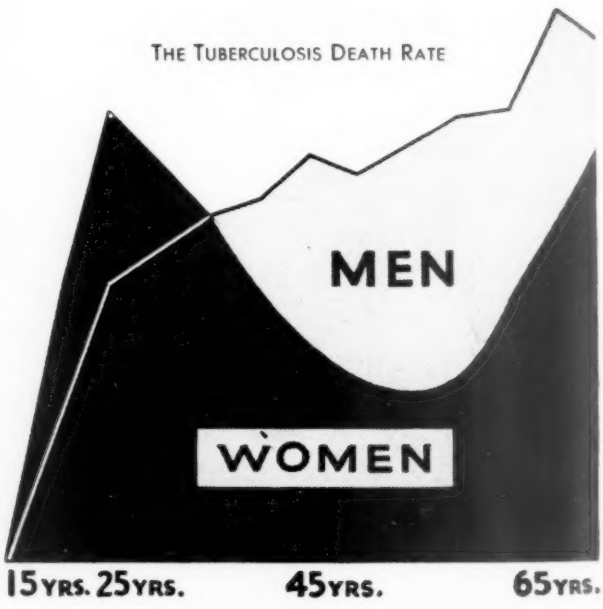

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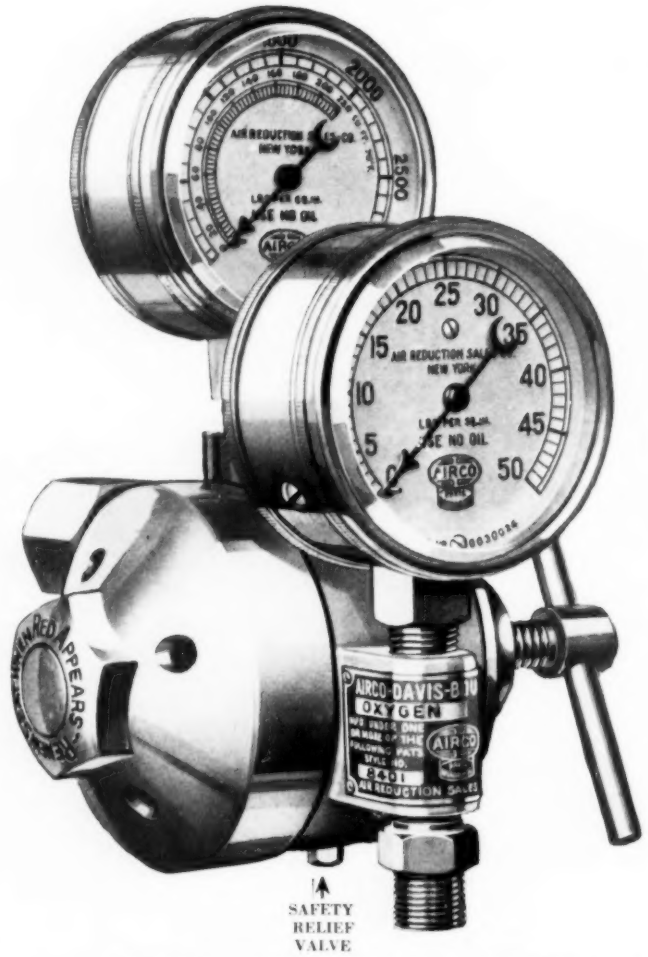

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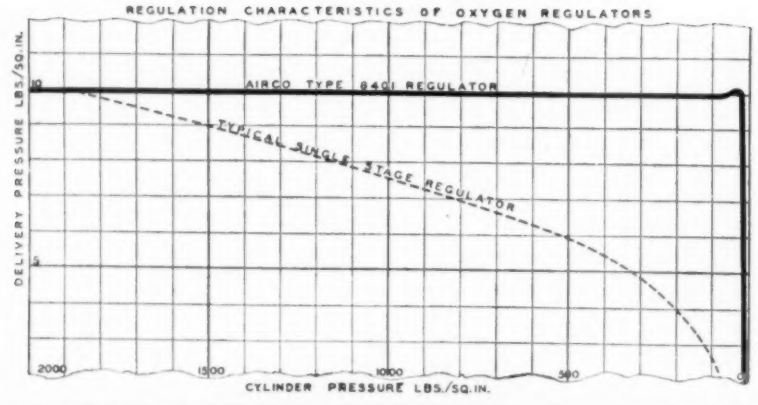

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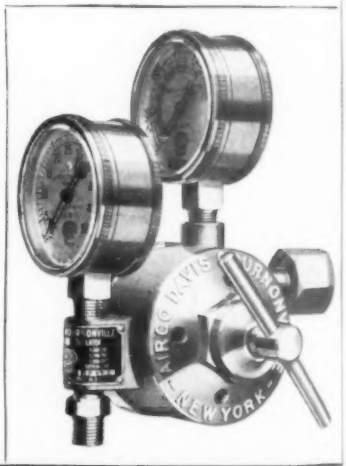

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Editorial

AGES ago, just before each Yuletide, people steeped in superstition watched with trepidation and fear as day after day the sun sank farther and farther toward the southern horizon. Then as the sun approached the winter solstice, it halted its southern journey and thereafter began a gradual climb back into the heavens. ¶ Each year, as the chill of winter crept on, dread and fear hung like a pall over the land, for who could be sure that the receding sun would come back again? Yet year after year it had returned and brought warmth and abundant harvests. ¶ But there were those who became impatient of waiting for the turn of the solstice and who reasoned: "No, the great ball in the heavens that gives us light and warmth is going farther and farther away, never to return. Haven't we watched it day after day in the hope that it would stay its southern journey, but all in vain?" ¶ Despite the forebodings of the fatalists, the sun has started its return journey at every Yule season, and this event is acclaimed by festivities and the burning of the Yule log. ¶ The Yuletide again is upon us. The sun of confidence and individual security has been receding, but now it has passed the solstice and is starting back on its return journey. ¶ Just as surely as the sun begins its upward climb at each Yuletide, so will good times follow reverses and despair. This Yule season ushers in a period of planning, reconstruction, and returning confidence that foretells the return of happy expectations.

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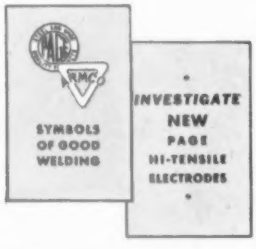

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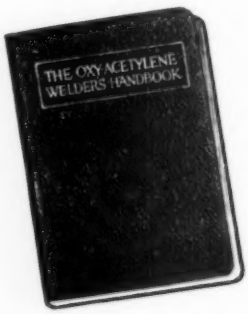

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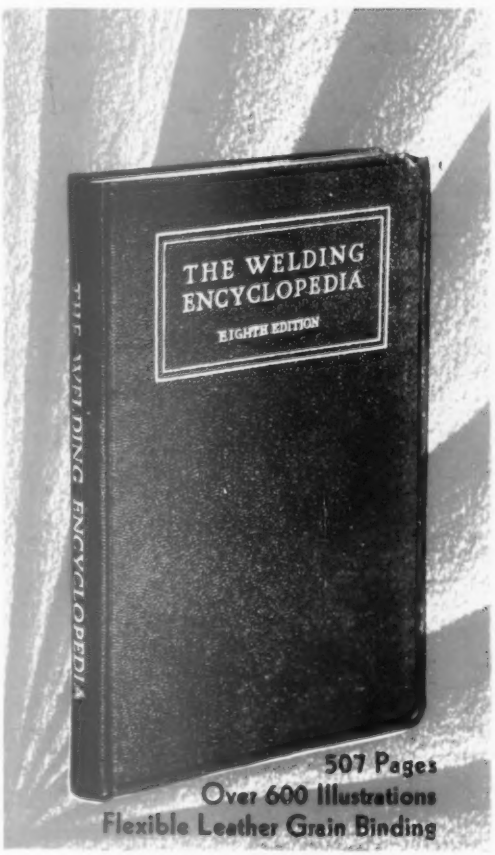

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